DOMINION OF CANADA.
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

MILK PRODUCTION IN CANADA

CROP ROTATIONS, DAIRY BARNS
BREEDING DAIRY CATTLE
FEEDING, CARE AND MANAGEMENT OF MILCH COWS

BY
J. H. Grisdale, B. Agr.,
Director, Dominion Experimental Farms.

BULLETIN No. 72
January, 1913

Published by direction of Hon. MARTIN BURRELL, Minister of Agriculture, Ottawa, Ont.

OTTAWA
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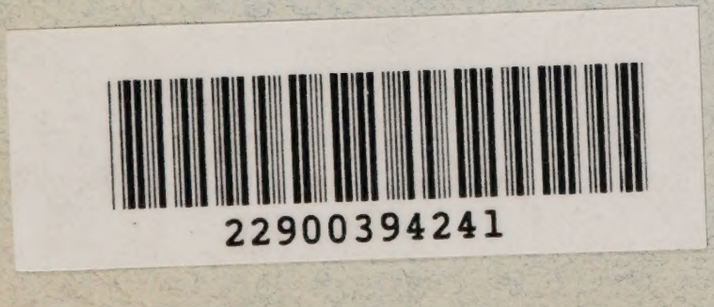

A group of Dairy Heifers at pasture, Experimental Farm, Ottawa. *Photo by F. T. Shutt.*

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To the Honourable,
The Minister of Agriculture,
Ottawa.

SIR,—I have the honour to submit herewith for your approval Bulletin No. 72 of the Experimental Farm Series, on 'Milk Production in Canada,' prepared by myself.

The ever-increasing importance of the dairying industry in Canada and the constant demand for information on the farmer's side of the question have made apparent the need for such a publication as the accompanying bulletin. It was proposed, at first, to issue a number of bulletins, each dealing with some particular phase of milk production, but the combining of the information appearing under different headings into one, rather bulky, bulletin has seemed advisable as being less expensive and, possibly, more convenient to the farmer.

For assistance in the preparation of this work I have to thank Mr. W. Logan, who did good service in the preparation of the tables of feed composition, in the collection of notes on rations as fed in different parts of Canada, and in the compilation and summarizing of results of experimental work with dairy cattle here.

It is hoped that this publication, though far from being as complete and comprehensive as the author would have liked, may prove of use to the many farmers interested in the dairy industry throughout Canada.

I have the honour to be, sir,
Your obedient servant,

J. H. GRISDALE,
Director, Dominion Experimental Farms.

Ottawa, January 25, 1913.

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MILK PRODUCTION IN CANADA.

INTRODUCTORY.

Farming operations in Canada may be varied to an almost unlimited extent. Here, as elsewhere, however, early agricultural effort has usually been along grain-farming lines, invariably a most exhausting system so far as the soil is concerned. With improved shipping facilities and increased population, however, different combinations of live stock and grain farming come into being until finally dairy farming makes its appearance.

Dairy farming is undoubtedly the system making for the greatest returns from the land in any particular year while at the same time not only maintaining but even increasing the fertility of the farm occupied. The possibilities of profits are therefore twofold: (1) increased crop returns and (2) most profitable and most convenient marketing of these crops and of every part thereof. The measure of the profits reaped will be the quality or economic value of the herd maintained, the methods of handling the same, and, to a certain extent, the business ability of the operator.

Men competent to express an opinion because conversant with conditions which obtain and results which have been secured in different parts of Canada, are of the opinion that a very large proportion of our Canadian dairy herds do not produce enough milk to pay their keep. From time to time, statistics seem to confirm this view. The fact that these cattle consume a certain amount of otherwise unmerchantable roughage and convert it into valuable fertilizing material would therefore appear to be about the only justification of this industry, an industry that for possibilities of money making to the thoughtful Canadian farmer is without a peer but which, as too commonly conducted, entails a loss or gives but poor returns for much hard labour performed and much good feed consumed.

The aim of this bulletin is, if possible, to help the dairying industry in Canada by placing in the hands of those interested a

brief summary of our findings in the dairy business. It is not claimed that all ideas submitted originated on the Dominion Experimental Farms, but all suggestions offered have either originated here or have been tried out on these farms and found generally satisfactory.

It is hoped that the information, suggestions, and pointers may prove of value to the dairying industry in this country, and the bulletin be of practical use to each individual farmer into whose hands it may happen to fall.

FACTORS AFFECTING RESULTS.

Many factors combine to make for success or failure in milk production. To say that any one or any group of influences is more important than another would be unwise, since any one, even the apparently most trivial consideration, might, under certain circumstances, prove the most important. There can be no doubt, however, that the following factors rank among the most important and it is under these headings that it is proposed to treat the subject in this publication:—

I. The farm chosen, the rotation followed and the crops grown.

II. The breed of cattle selected, and breeding methods followed.

III. Stables, and care and management of the herd.

IV. Milking and care of milk.

V. Feeding methods and rations.

These are not given in order of importance but rather from the bottom or foundation upward, or from the beginning forward.

PART I.—THE FARM.

THE FARM TO SELECT.

Milk production may be carried on successfully on practically any farm. In many cases milk is produced profitably where the only property owned or occupied is a stable, as witness numerous milkmen's herds in cities. While any farm suitably located is suitable for milk production, some farms are undoubtedly more suitable than others.

Soil.—A farm to be eminently adapted to milk production should have a plentiful supply of pure water. The lay of the land should be such as to permit of its being well drained. The best results may be expected where the soil is of the best quality but dairy farming can be successfully followed on almost any soil from the lightest sand to the heaviest clay.

Area.—The area of arable land under crops other than pasture each year should include about as many acres as it is hoped to carry head of cattle when the herd has reached its maximum of size and production. Too great value should not be placed on rough land for pasturing purposes unless it is low-lying and fertile.

Location.—Proximity to market or factory is an important consideration. When milk is sold long hauls are expensive. Where cream is the product shipped, distance from point of delivery to factory or train is not so important. When cheese or butter is manufactured on the farm, remoteness from shipping point is a minor consideration provided always that suitable storage conditions exist.

CROPS AND CROP ROTATIONS.

Crops to grow.—The farm having been selected it is important to so handle it as to provide the cheapest supply of the most suitable feeds the year round. This means plenty of succulent forage from January 1 to December 31. It should also include plenty of clover or some suitable substitute. As to grain crops advisable, a mixture of oats, peas, and barley would probably give best results.

Succulent forage might be either ensilage or roots. In most parts of Canada, Indian corn is the most suitable crop for ensilage, but clover, alfalfa and a variety of other crops give good results. Where roots can be grown to better advantage than corn, turnips, mangels, or sugar beets may be used, mangels and sugar beets being the sorts likely to give best results.

ROTATIONS SUITABLE FOR DAIRY FARMING IN EASTERN PROVINCES AND BRITISH COLUMBIA.

Rotations.—To produce these feeds in right proportion and at the same time maintain or increase the fertility of the soil, a short rotation is necessary. In Ontario, Quebec, the Maritime Provinces, and British Columbia, rotations of three and four years will be found best.

A good three-year rotation is as follows:—

1st year.—Corn, roots, potatoes or peas. Spring ploughed for corn, summer ploughed if for roots, manured in either case.

2nd year.—Cereals seeded down. 6 lbs. red clover, 2 lbs. alsike, 7 lbs. alfalfa, 6 lbs. timothy per acre.

3rd year.—Hay or part hay and part pasture, followed by corn, etc., the next year.

A good four-year rotation is as follows:—

1st year.—Corn, roots, potatoes or peas. Land ploughed for roots, potatoes or peas early preceding fall. Corn land ploughed spring. Corn, root, and potato land manured.

2nd year.—Grain, mixture, peas 1 bus., barley 1 bus., oats, 2 bus., sown at rate of 3 bus. per acre. Seeded down with red clover, 6 lbs., alsike, 2 lbs., alfalfa, 7 or 8 lbs., and timothy, 6 lbs. per acre.

3rd year.—Part pasture, part hay or hay cut early and pasture part of aftermath. Cut two crops hay off part of area.

4th year.—Hay and pasture. Part intended for roots, potatoes or peas to be ploughed early in August, rolled, disced and cultivated. Corn area ploughed next spring. Manure applied as convenient during summer, winter and spring preparatory to corn and other hoed crop.

Where practically the whole farm consists of arable land under cultivation it will be found much more profitable to soil or feed cattle during summer, in part at least, rather than depend upon pasture exclusively.

The Corn Harvest, Ottawa. The Corn crop is a great milk-producer.

Filling the Silos at Ottawa.

Where possible to grow corn to advantage, corn ensilage will be found to be the best forage for summer feeding. Where no silo is available or where green forage is preferred, a combination of the three and four-year rotations will be found satisfactory. The four-year rotation should include about three-fourths of the arable land and the three-year rotation the other fourth.

The four-year rotation land would then provide forage for winter and spring, and pasture for spring and summer. The three year rotation land would supply feed for summer and autumn and a small amount of pasture. A glance at the following diagram will indicate what might be the arrangement of the fields and the crops thereon in the case of a 100-acre farm where in addition to orchards, gardens, etc., about 60 acres could be brought under the plough. Fields F1, F2, F3, and F4 would be under the four-year rotation and would be cropped as indicated. Fields T1, T2, and T3 would be under the three-year rotation and would be cropped as indicated.

EXPLANATION OF SIGNS ON DIAGRAM.

A.—Dwelling house.
B.—Shed.
C.—Poultry house.
D.—Horse stable.
E.—Implement shed.
F.—Cow barn, feed room and silos.
G.—Pig pens.

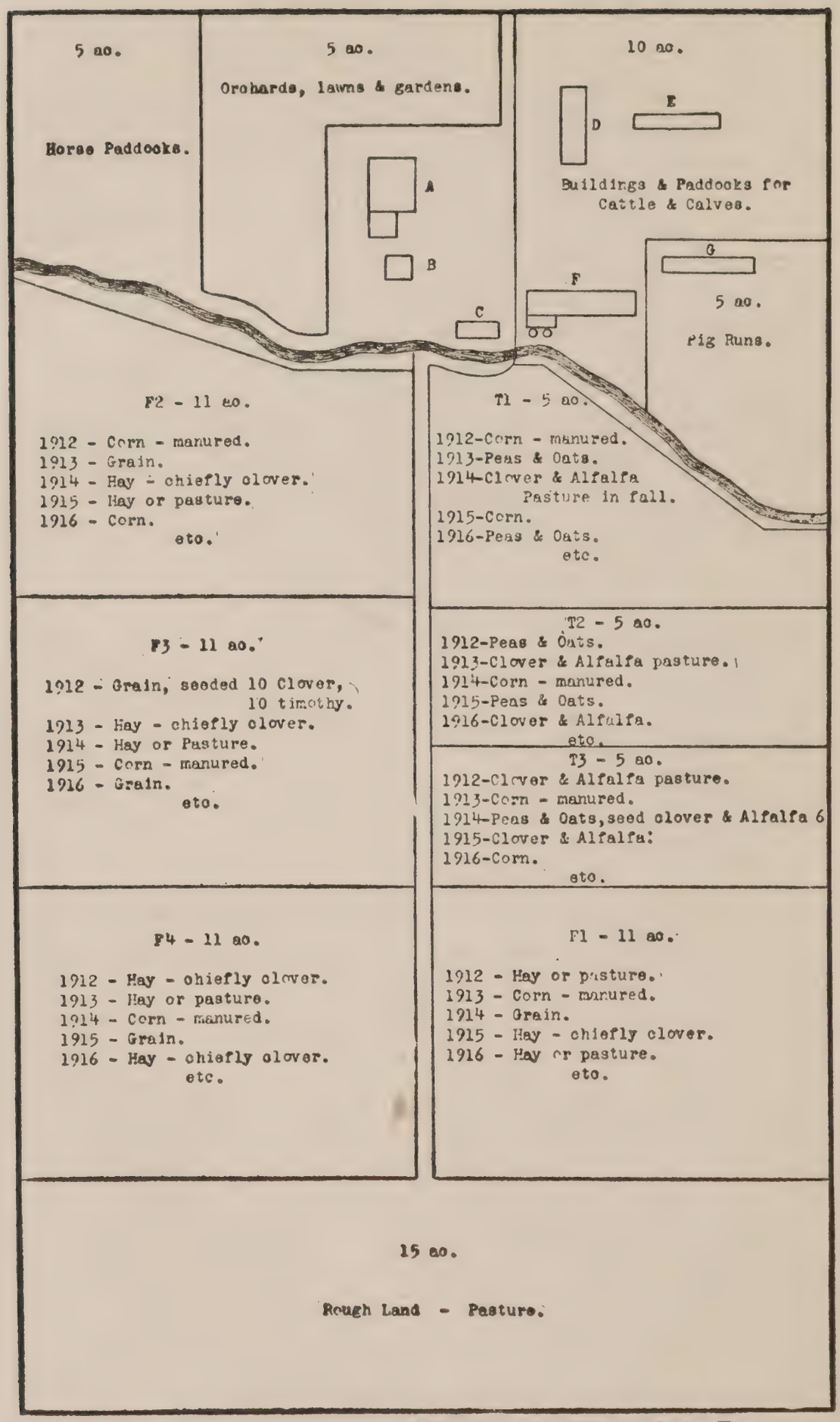

FIG. 1.—Suitable Arrangement and Roattions for a 100-acre Dairy Farm.

DAIRY FARM ROTATIONS IN MANITOBA, SASKATCHEWAN AND ALBERTA.

In Manitoba a rotation that has given good results on the Experimental Farm at Brandon and at various other points and one that appears to the writer to be fairly suitable for dairy farming is as follows:—

1st year.—Corn or roots. Disc after harvesting. Do not plough.

2nd year.—Wheat. Double disc stubble at harvesting, Disc seed in next spring.

3rd year.—Wheat or coarse grain; again double disc stubble. Plough 6 inches September or October.

4th year.—Coarse grain seeded down 10 lbs. timothy, 10 lbs. clover.

5th year.—Hay.

6th year.—Pasture. Plough shallow (3 inches) and pack in July. Work at intervals. Plough deeper (6 inches) in October. Manure on surface; work in with disc and drag harrow.

This rotation does away with the summer-fallow. It is sometimes hard to get a catch of grass and clover. Great care must be exercised to see that all cultural operations are properly performed.

SASKATCHEWAN.

In Saskatchewan we have not yet sufficient information available to permit even suggesting a probably suitable rotation. Our trials have, however, shown that it is possible to grow red clover, alsike, alfalfa, and corn, turnips, mangels, sugar beets, and a great variety of grasses over a very large part of this province, and this fact is significant of the tremendous possibilities of the prairies as live stock districts and more particularly as areas where the dairying industry may be expected to prove eminently practicable and highly profitable.

ALBERTA.

In Alberta the irrigated areas in the south with their abundant root and alfalfa crops provide such forage as cannot be surpassed for milk production. In the central parts of the province, the abundant grass, the rolling plain diversified with park and dale, make ideal pasture lands for dairy cattle. The forage crops possible of cultivation include alfalfa, roots and corn, hence everything points to this province becoming more and more interested in live stock generally and in milk production in particular.

PART II.—THE COW.

THE BREED TO USE.

The right farm found, the crops to grow determined, and the rotation arranged, the prospective milk producer must next decide what sort of cattle to keep. No man can say positively what breed or class of cattle will do best under any given conditions. Any and every experienced dairy farmer will, however, concede the absolute necessity of using either pure breds or grades of one of the recognized dairy breeds of cattle if the greatest profits are desired.

No breed of cattle is the best breed for Canada any more than for any other country. Generally speaking, the best breed is the breed the man likes best. It might be ventured that under average farm conditions when milk is sent to a cheese factory or shipped to a city, Ayrshires, Holsteins, Dutch Belted, or the grades of any one of these breeds would be suitable. Where cream is shipped, where butter is manufactured on the farm, or where milk is sent to a creamery, then Canadians, Guernseys, Jerseys, Dairy Shorthorns, or the grades of any one of these breeds would be likely to give most satisfactory returns.

Besides the consideration of a market or the utilization of the milk, the character of the farm to be occupied might, other things being equal, exert an influence on the selection of the breed wherewith to work. On heavy land in sheltered places, where pasture is abundant, the Holstein, Jersey or Guernsey would possibly give best results; on lighter, more exposed, and more or less hilly land, the Ayrshire might be the best. On exposed land, where there is scattered pasturage which may not be very abundant, the French Canadian cow would perhaps be the most profitable.

One fact, however, should be kept in mind: whatever breed is settled upon, whether for breeding registered cattle or for grades, 'stick to it.' It is possible to make a success of dairying with any one of the breeds mentioned almost anywhere in Canada. Changing from breed to breed means loss of time in the case of pure breds to say nothing of almost certain heavy financial loss, while in the case of grade herds it means almost always the most utter failure. This holds of course except in the case of the breeder who has strength of mind enough to make one decisive change and then 'stick to it,' that is, does not try first one breed of bull and then another, seeking something each time that will correct what he

considers the faults of the progeny of the previous sire of some other breed.

BREEDS OF DAIRY CATTLE.

It would be unwise in a bulletin so limited as this must necessarily be, to attempt to give a full history and an elaborate description of even the few dairy breeds above enumerated, to say nothing of the various other breeds with some claim to recognition as economical milk-producers. To omit all remarks on the subject would, however, possibly be open to still greater criticism and accordingly the following brief notes on the history, appearance and peculiar aptitudes of the principal breeds as known to Canadian dairy farmers are submitted.

AYRSHIRE.

The Ayrshire is one of the principal breeds of dairy cattle in America. They are medium-sized animals, spotted red, or brown and white. They possess great vitality, are of a nervous disposition, and respond readily to good feeding. They are hardy and well suited for rough pasture and scant herbage. They yield a fairly large flow of milk of medium quality. A common yield is 8,000 pounds of 3½ to 4 per cent milk in 9 or 10 months. Their chief faults are a tendency to beefiness, shown by a rather large proportion of the breed, and the very common and rather serious defect of small teats.

As the name implies, the Ayrshire had its origin in Scotland. The south-western portion of that country was in a very poor state as far as agriculture was concerned at the end of the 18th century. An historian of that period says that there were no crops whatever sown, and all the food the cattle had was the grass in the bogs and wastes. Under these circumstances the cattle were starved in winter, 'being scarcely able to rise in the spring.' Such were the conditions from which the hardy, useful race of Ayrshire cattle has come. It may be inferred that only the fittest survived, and the inherent hardiness seems to have been but little disturbed by whatever crosses have been made. It is supposed that these native cattle were crossed with imported Teeswater or Durham cattle, and with Alderneys or Jerseys, though there is no historical evidence of this.

The first importations of Ayrshire cattle into Canada were made between 1820 and 1830. For some time they did not meet with much favour, but with the formation of Breeders' Organizations, Dairy Tests, and Advanced Registers they have taken their rightful

place, and every year sees greater numbers of them imported from Scotland.

DUTCH BELTED.

Dutch Belted cattle are bred to a very limited extent indeed in Canada. This breed has been long in the upbuilding, but the basis of selection having been the clear, wide band of white around the body, the results of centuries of work are far from satisfactory from the dairyman's standpoint. The breed might be considered as ornamental rather than useful.

FRENCH-CANADIAN.

The French Canadian cows are worthy of much consideration where a hardy breed of rustlers is required. The individual cow is somewhat small, weighing only 700 to 900 pounds. A bull weighs about 1,000 pounds. In general conformation they are somewhat rough and angular; in the cows the wedge shape is present. The colour is black, or dark-brown. As milk producers they resemble the Jersey, though in quantity and quality they fall somewhat behind that breed. An average of 6,500 lbs. of milk of a little over 4 per cent butter fat is about the standard.

The first individuals of the breed are supposed to have come over from Normandy or Brittany with the early French settlers in the 17th century. Many years of 'roughing it' along with the early settlers have made them hardy, and selection by the same people has made them productive on light, poor rations.

GUERNSEY.

As the name indicates, the Guernsey is one of the breeds native to the Channel Islands. On account of the scarcity of animals, the breed is not very widely distributed. They are found in small numbers in the Maritime Provinces, a few herds exist in Quebec and Ontario, and even in the prairie provinces and British Columbia herds are to be seen here and there. The total number of Guernseys in Canada is, however, quite small.

Next to the Holstein, the Guernsey is the largest of the special-purpose dairy breeds. Orange-fawn-and-white in colour, they possess a skin remarkable for the large amount of yellow pigment or secretion which it contains. They yield a fairly large flow of rich milk of a very high colour. Some of the most remarkable butter-fat producing cows in the world are found in this breed.

HOLSTEIN-FRIESIAN.

Holstein or Holstein-Friesian cattle are large, black-and-white animals. Rather coarse-boned, rough and strong in appearance, they are, withal, heavy milkers and the largest of the purely dairy breeds. Coming, as their name indicates, from the low-lying, rich lands of Holland, they are peculiarly well fitted for heavy and low-lying farms in this country where they may be expected to prove more profitable than the small finer breeds for general dairy farming. With proper care and feeding, a fair cow of the breed should produce, when five years old or over, from 8,000 to 10,000 lbs. of milk in a year, though there are records of cows yielding as high as 30,000 lbs. in a like period.

It is probable that the Holstein-Friesian was introduced into America by the Dutch who settled in what is now New York State, since black-and-white cattle, known as Dutch cattle, have long been owned in the New England States. Toward the end of the 18th century, an importation, consisting of two bulls and six cows, was made by the Holland Land Company which owned land in New York State. Since then, frequent shipments have been made into both the United States and Canada; toward the end of the last century, however, these fell off to a large extent.

JERSEY.

The Jersey, introduced into this country many years ago, must always remain one of the most popular breeds of dairy cattle where quality of product and beauty of individual are considered. In appearance the Jersey is lean and muscular, the general outline conforming to the dairy type. The colour is fawn, but runs through many shades.

The Island of Jersey, of something under 30,000 acres with 60,000 inhabitants, is the original home of the breed, some 10,000 individuals being kept there by the system of 'tethering.' The breed probably sprang from the old Normandy or Brittany cattle though there is no definite proof of this. The purity of the breed has been jealously guarded by the natives of the island and, as far back as 1763, laws were passed prohibiting the importation of cattle of any kind. Much improvement in the breed has also been effected by the islanders, at first only along the lines of 'quality' in milk. It was not until 1865 that much, if any, thought was given to the produc-

tion of 'quantity,' but since that year, this too has received its meed of attention.

The earliest authentic records point to the first importation of this breed into America having been made about the middle of the 19th century, though it is known that some Channel Island cattle, whether Jersey or Guernsey, had been brought here very much earlier. Their ready adaptability to conditions has created for them a great demand, and they are now very widely distributed over Canada and the United States.

GENERAL PURPOSE CATTLE.

The General Purpose, Dual Purpose, or Farmer's, cow, as variously called, means the cow or class of cow that, in addition to yielding a fairly profitable flow of milk, carries a large frame capable of being fed into a good beef carcase. In spite of the claims of advocates of specialization,—those who hold that animals should be selected for one special purpose,—the demand for dual purpose cattle is extremely widespread in this country. Many farmers prefer a type of cow that will produce a fair quantity of milk, that will fatten easily, and will produce offspring that can be fed into good veals or steers. This class of cow is no doubt peculiarly adapted for such sections as afford more or less extensive areas of rough land suitable for grazing.

Many breeds have claims to a place in this class but the more common are: Brown Swiss, Devons, Lincoln Reds, Red Polls, Shorthorns, and Sussex.

Only a few remarks on each breed are submitted.

BROWN SWISS.

The individuals of this breed are fairly large, exceedingly strong-boned, and distinctly blocky. The body shows a great deal of feeding capacity with plenty of depth. The colour is a light or dark brown.

Coming originally from Switzerland, as their name implies, they were first imported into America in 1869. Several importations have been made from time to time since then, though the breed has not gained much in favour. In Canada only very few herds are to be found.

DEVON.

The Devons, long bred in the southern part of England, have

Guernsey Bull—Dairymaid's King—His dam has a record of 12176·9 lbs milk and 668·36 lbs. butter fat in one year. He heads the Guernsey herd at Ottawa.

A Jersey Bull.

Ayrshire Bull—Bargenoch Victor Hugo. Sold at public auction for $2,600 as a 3 yr. old.

Holstein Bull—Schiuling Sir Posch—3707—Sire of two official record daughters in 1911

been introduced into Canada only to a very limited extent. They are red in colour, compact in build, and they produce milk in fairly paying quantities. They are peculiarly suited for the farmer who wishes to produce both beef and milk on land of a light or hilly character. They are famous for the oxen produced in the breed.

LINCOLN RED.

The Lincoln Reds make up merely a branch of the Shorthorn breed, not a few of the animals registered in the Lincoln Red Herd Book being likewise entered in the Coates' Shorthorn Herd Book of Great Britain. The cows are, as a rule, heavy milkers but the steers of the breed make but second-rate beef animals. They have never been bred in Canada under the name Lincoln Reds.

RED POLL.

The Red Polls come from almost the same part of England as the Devons and possess many similar characteristics. They are larger-sized, however, and are probably better suited for general farming than the Devons as they are heavier milkers and yield larger carcases.

SHORTHORN.

To outline even briefly the history of the Shorthorn in Canada would be quite impossible in a bulletin such as this. The breed and the main facts of its history are, however, so well known as to need little comment here. Many strains of this far-famed breed are noted for large yields of milk, while their unequalled value as beef producing animals is universally acknowledged. A number of herds notable for milk-production have been established in Canada at one time and another. Two individuals in a herd established and maintained on the Central Experimental Farm for some years, produced over 11,000 lbs. of milk each in single lactation periods. The average yield of milk from this herd was about 6,000 lbs. a year for several years. Steers from these heavy milking cows when finished for beef were considered first-class beef animals.

In England, the Shorthorn with its grades and crosses is used almost universally for milk production. It is *par excellence* the farmer's cow—the 'rent payer.'

SUSSEX.

The individuals of this, another English breed, are large cattle, blocky in form, inclining to coarseness, solid red in colour. They have never been bred to any extent in Canada.

KEEPING UP THE HERD.

The breed having been decided upon, the method of maintaining the herd at a certain standard of efficiency or of increasing its milk-producing capacity must next be considered. There are three methods commonly followed in Canada.

1. Buying springers, or new-calved cows from time to time as required and either selling when dry, or breeding to any bull available, the calves being slaughtered at birth or vealed as convenient. This line is the one commonly followed by farmers or milkmen shipping milk to cities. It is a method no farmer should consider for a minute.

2. Starting with any grades available and using a good pure bred bull of the breed chosen as being most to the liking or best suited to the requirements of the farmer, is the second method and, with modifications, the one most to be recommended to the average farmer. It permits of the upbuilding of a highly profitable herd from the producer's standpoint. The writer has known many herds in Canada built up in this way where the returns ran from $75 to $150 per cow in herds of from 10 to 100. This method is open to the objection that male calves must go as vealers and that females are not as valuable as they would be if pure bred. Of course, when starting with a grade female, no number of crosses of pure bred sires would ever enable a man to register any of his calves. The advantage lies in the very searching selection it is possible to make in raising calves, since calves from poor cows need never be kept and inferior cows are not likely to be retained in the herd for any length of time as the temptation of fictitious pedigree values is eliminated. Where it is desired ultimately to get into pure bred cattle, a good plan is to start with a herd largely grades and invest in one or two extra good females as well as a bull of the breed desired. The pure breds proving to be really good individuals, the calves can then be raised and in a short time a herd of pure breds of the breed favoured is gradually driving the grades from the stable.

3. Where considerable capital is available, and experience in breeding and feeding is part of the owner's equipment or where some other circumstance makes success highly probable, even the beginning of operations in milk production might be made with pure breds. In such a case, it will usually be found advisable to start with a few

animals of superior quality rather than with a large number of small or even average worth. This is the third and most risky method.

Of the three methods, experience and observation lead the writer to most strongly recommend the second to the young farmer and also to the man long engaged in the milk-producing business unless exceptional conditions point clearly to the probability of the third method proving a success from the start.

THE DAIRY BULL.

In any case, the upbuilding of a good dairy herd without the use of a good dairy bull is impracticable. The maintenance of the herd in the highest state of productivity for any considerable length of time without having such an animal at the head thereof may be said to be impossible.

CHOOSING THE BULL.

The selection of a sire fit to head the herd is difficult. So-called dairy conformation, that is, conformation supposed to entitle the bull to honours in the show-ring, is not an unfailing indication of good stock-getting qualities. The best way to select the dairy bull is to judge him by the milk records on both sides of his family. In addition, attention must, of course, be paid to the bull himself. No animal strikingly weak, or of very faulty conformation should be used even when coming from heavy milking stock. Such individuals are more likely to perpetuate their own faulty conformation than to transmit the heavy milk-producing peculiarities of their ancestry.

No breeder of pure bred dairy stock who considers himself worthy the name, should keep a cow whose records he does not care to know, or attempt to sell a bull for the high milk-producing qualities of whose ancestry he is not ready to vouch. Such records, while becoming more and more common, have not yet risen to the high place they are ultimately bound to occupy in the estimation of the average dairy farmer. The dairyman willing to buy a bull without taking the trouble to learn something of the milk-producing qualities of his ancestry, and the breeder unable or unwilling to give such information are equally guilty of failing in their duty to themselves and to the dairying interests of their country.

When selecting a mature or aged bull, the purchaser should first assure himself that the animal possesses plenty of vigour and vitality. A soft hide and fine, silky hair, a bright eye and broad forehead, a strong crest, broad, deep chest and good heart girth all unite to declare the individual healthy, robust, and vigorous. No coarseness or beefiness should be in evidence. An openness or looseness of the bony system is desirable. The body should be large and deep with well-sprung ribs indicating feeding capacity. The quarters should be long and fairly broad; peakedness at the pins is objectionable. The thighs should be well muscled but comparatively free from fat and the twist should be well split up. The flank should be high, indicating room for a good udder on a cow of similar conformation. A straight-away clean walk and stylish appearance are very valuable features.

MATURE BULLS BEST.

A very large proportion of our dairy farmers are prejudiced against old or even against mature bulls. No more injurious practice can be imagined than placing a succession of young bulls at the head of the herd. Loss results in various ways. In the first place the progeny are not likely to be as vigorous from an immature sire as from a well-developed, fully-grown animal. Further, if it is desired to really improve the herd the continuous changing of sires is likely to detract materially from the uniformity of type and distinctive peculiarities which must characterize all herds worthy the name of 'breeding herd.'

So far as age influences the reproductive powers of the sire, it may be said to be for the better rather than the reverse up to a fairly advanced age at least. At the Experimental Farm here, bulls of various breeds have been kept till 8 or 10 years old and proven quite satisfactory up to the very last, invariably leaving strong, well-developed calves. The writer knows of various bulls 10, 11, and even 12 years old that are still leaving good stock.

The objection is sometimes raised that old bulls are vicious and hard to handle. This objection is occasionally well grounded. It might in almost every case be overcome by giving the bull plenty of exercise. Work on a tread power, work hauling some vehicle, a run in a good large paddock, all would do much to soften the temper, to say nothing of improving his procreative powers.

The question as to what extent a given bull may be used in the herd is one of very great importance. Generally speaking, where pure bred females are being used, it is not advisable to use a bull on his own offspring. Cases might occur where in order to fix certain very desirable peculiarities the use of the sire on one of the most suitable, that is one of the most robust, of his own get might be permitted or even recommended. In grade herds, however, especially where the dams are of a nondescript character, the sire may frequently be used on his own get with most satisfactory results. Under such circumstances, the infusion of the entirely new blood of the sire is likely to lend vigour and growthiness to the offspring and so permit of his being used on the first generation with a view to getting as much as possible of the superior blood of the sire into the females of the herd it is desired to improve.

The writer has seen this line of breeding followed in several cases and has tried it in his own herd with gratifying results. It is often asserted that weaklings result from such crosses, but this is likely to be true only when pure breds of a peculiarly weak character are the subjects chosen with which to work.

In selecting bulls, care should be taken to choose animals uniform in type, since in this way only may one hope to achieve the honour and reap the advantage of having a uniform and distinctive herd. It is also necessary to bear in mind any weakness it is desired to correct and to secure a sire well developed where the herd or some animals thereof are weak. These aims are of course in addition to, or rather in connection with, the ever-present and all-important consideration of improving the milking qualities of the breed and more particularly of the herd in question.

THE FINANCIAL SIDE.

Too great cost is the objection most commonly put forward by the farmer hesitant about the purchase of a good dairy bull. A consideration of the business side of the venture should do much to convince the dairyman that the investment of even a considerable sum in the purchase of a first class dairy bull is money quite wisely and most profitably spent.

Experience has demonstrated over and over again that heifers sired by a really good dairy bull are capable of producing from 5 to 10 lbs. a day more milk than heifers sired by scrub bulls and from

the same or similar cows. This being the case, as all having any experience must admit it to be, we might proceed to form an estimate of the value of the bull.

Suppose the herd considered be one of 20 cows—a number quite common in many parts of Canada. To keep up such a herd the owner will need to raise from 5 to 8 calves a year—say an average of 6 yearly. Five of these heifers are likely to come to maturity and each one will give, say, 5 lbs. a day more milk than would a scrub heifer under like conditions. The period of lactation being about 300 days, there would thus be 1,500 lbs. of milk more in the year from one heifer. Since the life of the milch cow as such is about 5 years, each heifer would be worth 7,500 lbs. more milk in her life than the scrub. There being 20 cows in the herd, these might soon all be replaced and the 20 cows would in their lifetime be worth 150,000 lbs. more milk than the scrubs. This amount of milk would be worth, say, $1,500. This sum, therefore, represents the returns from a good bull in the small herd of 20 cows. He would be worth relatively more in larger herds.

A really good bull calf of any one of the breeds commonly kept in Canada can usually be bought for from $50 to $100. Financially it looks like a good venture.

FEED AND CARE.

No set rules can be given as to the care and feeding of the dairy bull. One bull will do well on feeds that, if given to another, would prove quite unsuitable.

In the first place, the bull should receive considerable feed of a bulky character. Oat straw, clover hay, corn stalks or stover, roots, etc., are all desirable. By way of meal when in the midst of a hard season, there is nothing better than a mixture of oats, bran and oil cake in quantities sufficient to keep him in fair shape. A good ration for a 1,500 pound bull would be:—

	Lbs.
Oat straw	5
Clover hay	20
Roots or grass	30
Meal mixture	3

Give more meal if necessary.

Certain methods of feeding and certain feeds are likely to render the bull sluggish in action and uncertain in service. The feeding

of coarse, non-nutritious forage in large quantities as, for example, corn ensilage, will sometimes develop so much middle and so sap vitality as to render the bull very clumsy and quite ineffective even when able to work. Where clover hay is lacking, its effects may be secured by feeding somewhat more freely with bran. This latter feed will also be found of great value when roots or other succulent feeds are largely lacking or entirely absent from the lists of available feeds.

DAIRY CALVES.

In choosing calves to raise to keep up or increase the dairy herd, the progeny of the best cows only should be selected, and these only if they are well-developed heifers. Many good calves from good cows develop into inferior dairy animals. This may be due to one single cause or to a combination of causes. The suggestions given below are based on our experience here for the last 18 years, during which time many hundreds of calves have been raised. It is confidently asserted that a close observance of the rules laid down will insure success in a large percentage of cases.

THE DAM.

The cow should be kept in good health and in good condition while carrying a calf. Particularly is this true during the 6 or 8 weeks immediately preceding parturition. The mature cow should be dried off at least six weeks previous to dropping her next calf, then put in good flesh.

In the case of the heifer with her first calf, she should have been fed generously and wisely during the whole period of pregnancy. Her food should have been such as would have been suitable for a cow in full flow of milk, the most suitable foods being pasture grass, clover hay, roots, ensilage, bran, oats, and oil meal.

THE CALF TO RAISE.

Objection is sometimes made to raising calves from heifers. If the heifers have been properly mated and wisely fed during pregnancy the calves are likely to prove as satisfactory as stock from older cows. In the case of grade heifers, however, it may scarcely be considered wise to raise the first calf since, the milking qualities being unknown, the breeder might later find himself with a six or nine months' calf from an unsatisfactory cow on his hands.

AT CALVING TIME.

The cow should be placed in a box stall a few days before she is due to calve. She should be kept on a somewhat lighter ration than usual and her food should be rather laxative in character, bran, clover, roots, or ensilage.

The calf may be left with her for two or three days. She should be milked in addition to what the calf draws from her. In the case of very heavy milking cows likely to suffer from milk fever, it is advisable to stop short of drawing off all the milk for three or four days. This practice has saved us all trouble from milk fever for the last five or six years.

FEEDING THE CALF.

The calf should be removed from the cow the second or third day. It should then be taught to drink. This may be done about as follows: Take a quart of warm new milk in a 10-quart pail. Give the calf two fingers to suck air between. Gradually lower its nose into the pail. When it finds milk instead of air entering between the fingers it is likely to relax the neck and start to take milk. Do not sink the nose so far into the milk as to cover the nostrils. If it will not drink at first, leave it for a few hours to work up an appetite. After a few days it may gradually be weaned from the fingers.

Whole milk should be fed for at least one week. During the next week the change from whole milk to skim milk should gradually be brought about. Substitute each day a regularly-increasing proportion of skim milk for the same amount of whole milk withdrawn.

The skim milk should be fed warm, from 90 to 100 degrees Fahr., no more and no less. To replace the fat that has been removed from the skim milk, as well as to furnish additional protein, it is well to add some flax seed jelly to the ration. This jelly should be added in small quantities at first and slowly increased. Begin with a dessert spoonful in each portion and gradually increase until about a cupful is being fed night and morning to the three months old calf.

To prepare the jelly, boil, or rather, steep, one pound of whole flaxseed in water almost boiling, until a thick paste results. Another method of preparation is to take half a cup of ground flax in a quart of water and allow to simmer just below the boiling point until a

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A bunch of "right condition" Dairy Calves.

thick jelly is formed. It should be kept cool and sweet until fed.

Another good jelly for mixing with the milk is prepared as follows:—

One part pure ground flax seed, two parts finely-ground corn meal sifted, two parts finely-ground oatmeal, sifted, and the whole well mixed; then boil and allow to stand for twelve hours covered. Begin with one-eighth pound per day for calves a month old; new milk for the month previous and no solids. Increase the allowance as the calf grows older but not to exceed a half-pound per day.

In addition to the flax seed jelly, or the calf meal just described, a little dry bran and whole oats should be fed. Start with very small quantities. Some clean, sweet, clover hay will be a valuable addition to the ration at a very early age.

Whey may be used where skim milk is not to be had. Change from milk to whey as from whole milk to skim milk (see method outlined above). The flax seed jelly, etc., should be used just as with skim milk.

Where skim milk or whey is not available, calves may be raised on hay tea. Boil cut clover, or even timothy, in water until a strong decoction or tea is obtained. Wean the calf from milk to this tea precisely as described above from whole milk to skim milk. The same supplementary feeds may be used in somewhat larger quantities.

The skim milk should be fed sweet for some time at least. If it is likely, however, that it will sometimes be sour it is advisable to gradually change to sour milk and feed sour milk invariably. The same counsel applies to whey.

Calves should be kept in scrupulously clean pens. These should be dry and warm in winter and dry and cool in summer.

A strict observance of the following general directions will almost certainly insure success:—

1. Treat calves kindly and carefully.

2. Be scrupulously clean as to food, pails or troughs, and pens or quarters.

3. Make all changes in character of food very gradually. This applies whether changes be as to temperature, percentage of butter fat, acidity or sweetness, quantity, times of feeding or any other feature in connection with the food.

4. Feed only wholesome food, feed regularly, and feed in sufficient quantities, but not too generously.

CALF FEEDERS.

A number of what are known as 'calf feeders' of various kinds have been tried here, but have been abandoned after a fair trial. The teaching of the calf to drink, then supplying the right quantity of the proper kind of food, in the right condition as to temperature and sweetness and in a clean vessel held firmly in place in such position as to render the contents easily accessible to the calf, but so protected as to prevent the calf getting its foot thereinto, is the best plan. Calf feeders are more apt to get out of order and to get dirty than are pails. Further, our experience is that they involve more labour.

CALF TIES.

Where more than one calf is confined in a stall, the use of some kind of tie to hold the calves during and for some little time immediately after feeding is very necessary. The stanchion is probably the best method for so tying them. They should be so placed as to permit of the vessel containing the food being held firmly in place in front of them. It is essential that the food be carefully apportioned and fed each calf in a separate pail.

WATER AND SALT.

In addition to a sufficient supply of suitable food, an abundance of water and a moderate amount of salt should be provided. Calves frequently suffer from lack of water. If water cannot be kept in front of them, they should be given an opportunity to drink at least twice a day. The water offered should be potable, that is, not too warm in hot weather and not too cold in cold weather. Salt can be best supplied in the form of rock salt. A lump in the manger will prove cheap and wholesome.

HEIFERS.

SELECTION.

From every herd there are some members to be removed every year, and it should be made a point that, whether the cause of removal be old age or poor production, the animal being introduced into the herd should be of higher merit than the retiring individual.

The farmer should, as already indicated, attempt to rear on his own farm, and from his own best cows, the animals which he will require to keep up or increase his herd. While he cannot be sure of every heifer reared from the best producers in the herd making good when coming into milk, still, knowing the dams, he may look for a semblance to them in the daughters.

Careful selection from well-bred animals is, however, not all that is required to make well-developed heifers. Good feeding also is necessary. It is absolute folly to expect that heifer calves will develop into first-class cows if they are stunted when young. It is perfectly legitimate to get a good ration at as low a cost as possible, but nothing except failure can come from trying to save money in the dairy business as in any other line of live stock enterprise by feeding a poor or insufficient ration, whether to old or young animals.

CARE AND FEEDING.

The calf stage is over with the sixth or seventh month or thereabouts. Upon the treatment accorded the heifer from that age till dropping the first calf, will depend very largely her future value as a dairy cow. Heifers from 6 months to 2 or 2½ years are usually supposed to be able to look after themselves. They really should have considerable care and attention at this time. The prime requisites are an abundant supply of suitable food and comfortable quarters. Foods suitable for this purpose are bright alfalfa, or clean, sweet, clover, and a small proportion of fine,soft straw; mangels, turnips, sugar beets, or ensilage; and a small amount, say 1 to 1½ lbs. daily, of a mixture of two or more of the following feeds: bran, oil cake meal, oats, gluten meal, pea meal. Bran or oats should always form part of the meal ration.

Where fall-dropped calves are raised they may safely be put on pasture in June provided always that an abundance of grass is available not only in early spring but throughout the summer. Shade or shelter from the hot summer sun is important at any age but doubly worthy of attention with heifers or young stock under one year old.

TIME TO SERVE.

The heifers should be bred at about 21 months old so that the first calves may be dropped at two-and-a-half years. This breeding age may be varied somewhat, according to the development of the

animal. If exceptionally large and strong, breeding at 18 months will do no harm; if rather backward, impregnation had better be put off till two years old.

TREATMENT DURING FIRST PERIOD OF GESTATION.

The last nine months before calving should see the budding matron given every consideration likely to make for her future success as a dairy cow. Kindly treatment, frequent handling, abundant, nutritious and at the same time bulky food, with considerable meal the last few weeks, will surely give good results. The heifer should come to the calving in good flesh and with the udder large, full and firm.

As the time of parturition approaches, the feeding of the heifer should be plain, without stimulating foods that might have a deleterious effect on the fœtus and cause abortion. Good clean hay from clover or mixed grasses, corn fodder and corn ensilage or roots should constitute the main portion of her diet.

TREATMENT DURING THE FIRST PERIOD OF LACTATION.

Directly after calving, a warm, thin slop of oatmeal, bran or shorts should be given, or, where the cow is weak or exhausted, warm water only. For a few days, until the danger of fever is over, the ration should be very light, and gradually increased for two or three weeks, when the heifer may be put on full feed.

A heifer with her first calf should receive special care and be fed liberally since she is growing and producing milk at the same time. A good supply of protein must be furnished in her ration to meet the requirements of the body for nitrogenous food components.

If the heifer be not bred again until some six months after the dropping of her first calf, she will be free to devote all her energies to the production of milk. This would tend to the establishment of the 'milking habit.'

SPRING OR FALL CALVING.

The question of spring or fall calving is one that so far as the relative merits of the two systems are concerned, can have but one answer, and that is that the cow should freshen at the season when her services are likely to be of the greatest use to the owner. So far as records are concerned, however, it is practically certain that, under average conditions in Canada, much better year-long records are likely to be made when the cow comes in in early autumn than when

she freshens at any other time. This is due not so much to any one circumstance or condition as to a combination of influences which might be summarized in part as follows: More equable temperature throughout early or heavy milking part of lactation period; freedom from extreme heat and flies, two enemies of big records that are very hard to combat; more time for the attention and care conducive and, one might say, essential to the making of extra good records.

DRY PERIOD.

Observation and experiment have shown that while, as already indicated, long lactation periods (10 to 11 months) are advantageous and desirable, a short period of idleness, or non-production between lactation periods, is very desirable. Cows that milk through from calving to calving seldom do well in the period subsequent to such unnatural performance. The cow should be dry from 3 to 6 weeks between periods, if best results are desired. Some farmers claim that the calf dropped when a cow milks through is likely to be weakly or small. The writer has been unable to satisfy himself that such is the case and is, on the contrary, led to believe by his observations that the mother, rather than the calf, is the one likely to show evil effects from the practice.

DRYING OFF.

In the case of heavy, persistent milkers, it is sometimes rather difficult to dry the cow off before she should begin to show signs of 'springing' or 'freshening.' If, however, the dairyman will go about the thing in earnest, not much real difficulty is likely to be experienced. A good line of action, we have found, is as follows: Cut off all meal or grain; give only dry feed and not even a superabundance of that. As soon as yield is perceptibly less, start to milk only once a day; somewhat later, milk every other day and shortly thereafter, stop entirely. The udder may get hard for a few days but will almost certainly go back to normal soft emptiness characteristic of dry cows in a very short time.

MILKING BEFORE CALVING.

When cows are in good flesh and in shape to milk well, it not infrequently happens that the udder becomes abnormally distended and hard before parturition. The question naturally arises whether it would not then be advisable to milk out before the cow drops her calf. This should, in the writer's opinion, be done only when there

is evidence of suffering. If, however, milk is drawn, it will be found necessary to continue drawing milk off at regular intervals, until the calf is dropped.

JUDGING THE DAIRY COW.

The cow of ancient days produced sufficient milk to feed her offspring. The cow of modern times does more or does less according as man has elected. In some breeds many individuals are found quite incapable of supplying their young with nourishment. In other breeds or even in all breeds individuals are found capable of supplying sufficient milk to feed three or four young. The long continued selection of such animals for breeding purposes has given us our valuable, special-purpose dairy breeds.

Many peculiarities of the heavy milking cow in any breed are more or less common to all good milking cows of all breeds. By the commonly used phrase 'good dairy form' is meant that peculiar conformation or shape of the animal indicative of the ability to produce milk in large quantities.

The power to produce much milk must naturally be associated with the capacity for consuming and properly digesting large quantities of food, since from the food comes the blood and from the blood the milk. It is safe, therefore, to demand always every indication of good digestive powers in the cow. The chief external signs of good digestion in the cow are a large abdomen, deep, broad or long, but preferably deep and broad and long; a mellow skin, affected of course more or less by length of time in milk; a large, strong mouth and jaw; a bright eye; and a strong constitution, that is, lots of room for the vital organs, the lungs and heart.

Of equal or greater importance than digestive power are milk producing indications. First must come a large udder, but at the same time one that milks out 'small and soft.' It should be broad and extend far along the belly and well up behind, being visible behind the thighs. It should be well attached to the body and cover a large part of the cow, the more it covers the better. It should have four good-sized, well-placed teats capable of yielding a large stream of milk from a fair pressure. (Small, strong-muscled teats are a vexation and a nuisance). The veins should be visible upon the surface of the udder and should be large and full and winding. The so called 'milk veins' leading forward from the udder, should, depending upon the age of the cow, be large, full, tortuous, and long. They should lead to good large 'milk wells' or openings in the

abdominal wall; a large vein with a small inlet is an indication of weakness rather than strength or good milking qualities.

The power to digest food and the possession of organs or characteristics indicating milk production on a large scale are of no value if not accompanied by the peculiar temperament which goes with the power to elaborate milk from blood, that peculiar nervous temperament which is the exact opposite of the placid character shown by the animal that makes flesh rather than milk out of its food. The nervous disposition always found in the good milch cow shows itself in the bright, prominent eye, in the large brain room indcated by the broad forehead, in the clean, fine bone, in the open joints and, generally speaking, in the loose, open character of the carcase as opposed to the closely knit, compact frame of the ideal beef animal.

There are many minor features of the dairy cow closely studied and examined by good judges of dairy cattle. Not a few men pay close attention to such features as the tail, the form of escutcheon or manner of growth of hair on the rear udder and inner thighs, the colour of pigment on the inner ear, the pelvic arch, and the arrangement of the vertebræ in the spinal column.

In judging individual cows, a not uncommon practice in the United States and Canada is to make use of what is known as the Score Card or Scale of Points. In these Score Cards the principal features of the cow are arranged in regular order and an arbitrary valuation placed on each. This valuation is supposed to indicate the relative importance of the different features when they are of that peculiar character or form that experience has shown to be associated with good dairy qualities. To arrive at some conclusion as to the value of a given animal by the use of the score card, values are set down indicating the scorer's estimate of the degree of excellence of each feature in comparison with what might be called the ideal type of that feature. The summing up of all the values given indicates the nearness of approach of the individual under consideration to what might be called the scorer's ideal cow.

Below is submitted a score card for dairy cows. This card was prepared by the writer some few years ago for use in some live stock judging work in which he took part. The figures in the first column in heavy type indicate the values assigned to the ideal of the feature in question. The figures in the second column are the values assigned by the writer to the cow whose photos appear on Plates 6, 7, 8, 9.

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Side view of "No. 3." See "Score Card." "Bessie Ann." Produced 14,287 lbs. of 3·46 per cent milk in one year as a 3 yr. old.

Rear view of "No. 3.' See "Score Card" "Bessie Ann."

Front view "No. 3." See "Score Card" "Bessie Ann."

Udder and veining view of "No, 3." See "Score Card." "Bessie Ann,"

DOMINION DEPARTMENT OF AGRICULTURE.

Live Stock Division.

STUDENT'S SCORE CARD—DAIRY CATTLE.

Scale of points.	Possible Score.	Student's Score.	Corrected Score.
A. General Appearance: 16 points.			
Estimated weight..... ....lbs.....	.....	.....	....
Form, wedge-shaped, as viewed from front and top; straight top line, and great depth of barrel.	5	4·5	4·8
Quality, hair, soft and fine; skin, of medium thickness, mellow and elastic; secretion, yellow; bone, fine and clean.....	6	4·3	5·5
Style, active, vigourous, showing strong character, temperament, inclined to nervousness, but not irritable or vicious.	5	4·5	4·7
B. Head and Neck: 8 points.			
Muzzle, broad and clearly defined; mouth and nostrils, large.....	1	1·0	·9
Eyes, large, prominent, clear and placid.....	1	1·0	·9
Face, lean and somewhat long, fine between muzzle and eyes.....	1	·6	·7
Forehead, broad.....	1	1·0	·8
Ears of fine texture and medium size; secretion, abundant.....	1	1·0	·8
Neck, thin, rather long, fine and clean at junction with head; no noticeable amount of dewlap....	3	2 6	2·2
C. Forequarters: 6 points.			
Withers, lean and sharp; vertebræ, somewhat higher than blades.....	2	2·0	1·8
Shoulders, light, fair distance through from point to point, but sharp on top; smoothly blended into body.....	2	2·0	1·9
Legs, fairly well apart, straight and short; shank, fine and smooth.....	2	2·0	2·0
D. Body: 22 points.			
Chest, fairly deep, full between and back of forelegs, no depression behind shoulder blade... ..	6	5·0	4·5
Ribs, long, broad and wide apart; moderately well sprung, giving a large, deep barrel.....	10	9·0	9·0
Back, lean, straight, and open jointed; sharp chine and broad loin	6	5·5	5·0
E. Hindquarters: 13 points.			
Hooks, wide apart.....	2	2·0	2·0
Rump, long and wide.....	3	3·0	2·5
Pin Bones, high and wide apart.....	1	1·0	1·0
Thighs, thin	2	1·5	1·6
Legs, straight and set well apart; shank, fine and smooth.....	2	1·8	1·5
Escutcheon, spreading over thighs and extending far upwards.....	2	2·0	1·9
Tail, long and fine, terminating in a switch of fine hair.....	1	1·0	1·0
F. Milk Vessels, Etc.: 35 points.			
Udder, long, wide, deep but not pendulous, firmly attached, extending well up behind and far forward: quarters, even and free from fleshiness..	25	22·5	20·0
Teats, large, uniform, and evenly placed.....	5	4·0	3·5
Milk veins, large, long, crooked, and branching.	3	2·5	2·0
Milk wells, large and numerous.....	2	1·8	1·3
Total....	100	89.1	83·8

Student's name, No. 14..... ....

Animal, No. 3.....Date Nov. 16, 1911. .....

The cuts subjoined show the location and approximately proper conformation of the features usually considered in judging the Dairy Cow.

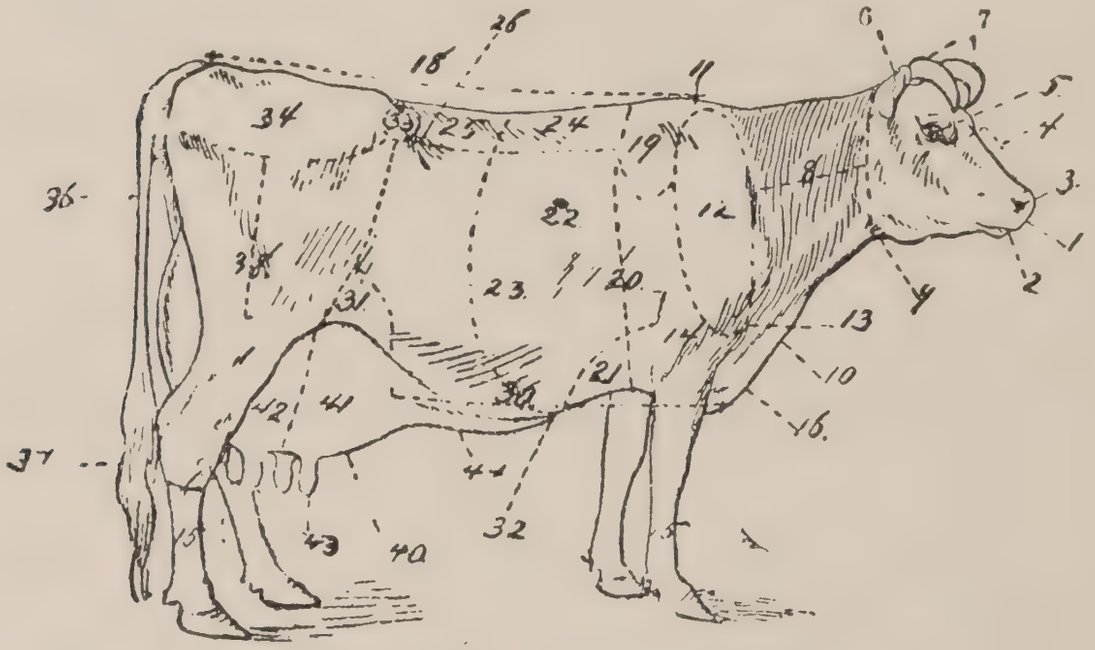

FIG. 2.—Points of a Dairy Cow, Side View.

DAIRY CATTLE.

Points of the Dairy Cow, Side View.

1. Muzzle.
2. Mouth.
3. Nostril.
4. Face.
5. Eye.
6. Ear.
7. Horns.
8. Neck.
9. Throat.
10. Dewlap.
11. Withers.
12. Shoulder.
13. Point of Shoulder.
14. Arm.
15. Shanks or Cannons.
16. Brisket.
21. Foreflank.
22. Ribs.
23. False Ribs.
24. Back or Chine.
25. Loin.
26. Coupling.
30. Underline.
31. Hind Flank.
32. Navel.
33. Hip or Point of Hip.
34. Rump.
36. Tail.
37. Switch or Brush.
38. Thigh.
40. Udder.
41. Fore udder.

18. Topline.
19. Crops.
20. Girth.
42. Hind udder.
43. Teats.
44. Mammary Veins or Milk Veins.

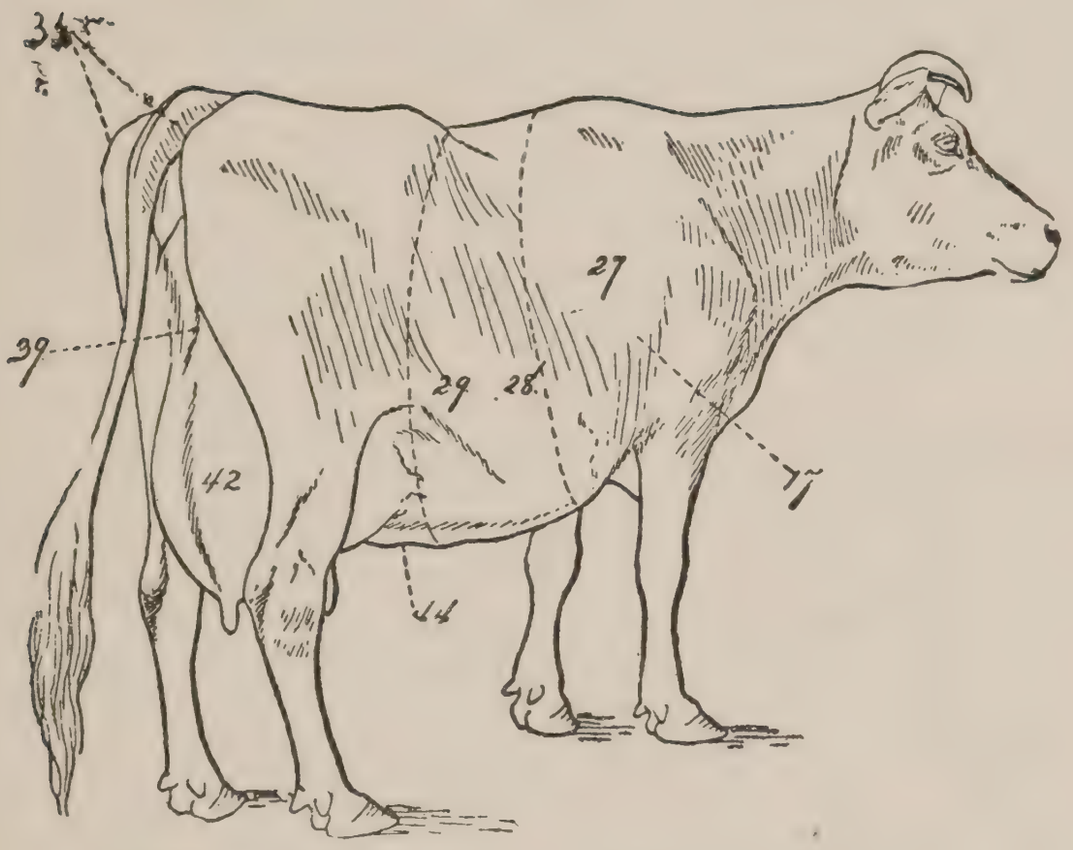

FIG. 3.—Points of the Dairy Cow, Three-quarters rear View.

Points of the Dairy Cow. Three-quarters rear View.

17. Chest.
27. Barrel.
28. Barrel Depression.
29. Stomach or belly.
35. Pin bones or thurls.
39. Escutcheon.
42. Hind udder.
44. Mammary Veins.

COW RECORDS.

The form and temperament of a cow are a fair index of her worth as a milker. When it is merely a question of selecting a number of dairy cows from the stock of the country, these peculiarities may be taken as fairly accurate guides in sorting out the probably profitable milk producers from the evident flesh formers or from the functionless scrubs that cumber our fields.

The would-be successful dairy farmer must aim higher than this, however, for no matter how carefully the selection be made, there is almost certain to be included a considerable number of unprofitable cows in a herd got together in this way. The only certain method for determining the real value of a dairy cow is the use of the weigh scale and the Babcock test. Common observation teaches us that different cows produce different amounts of milk and butter fat in the same period of time, but it is practically impossible to estimate within 1,000 lbs. of what a cow will do in a year by merely watching the amount of milk given each day. One thousand pounds of milk more or less than a certain standard in a year means a fair profit or a serious loss. Hence the importance of knowing what each cow is doing.

To really know what each cow is doing necessitates the keeping of a record of the amount and quality of the milk produced during the whole lactation period. This record might be, and had better be, made day by day, but valuable information may be secured by weighing and recording the morning's and night's milk of the cow on the 1st, the 10th, and the 20th day of each month. The multiplying by ten of the total amount so recorded during the lactation period will give a good idea of what the cow has really been doing. Tests as to the fat content should be made from time to time.

Blank forms whereon to enter the milk produced by each cow at each milking are supplied free of charge to all applying for them. They are of the form submitted below, or are large enough to include the milk for 31 days, that is, for any given month.

In starting out to build up a good dairy herd it is necessary to know exactly every cow in the herd. To know 'about how much' a cow can do is of very little value. Exact knowledge of the power of each cow as a milk and butter producer is absolutely necessary if the best results are aimed at.

Many farmers who have been keeping such records for some time report very strongly in favour of this line of work. As soon as the farmer sets to work to know what his cows are doing by keeping a record, he finds himself much more closely in touch with his business. He sees at once the effect of better care and better feeding. He notes the great difference in returns between the best and the worst cows in his herd and cannot help but determine to get rid of the poor ones and replace them with good ones. Even the

poor cows are improved, because better feeding is almost certain to be tried. And quite certainly poor feeding is responsible for many of our unprofitable dairy cows and even many unprofitable dairy herds.

As an example of the interesting information that can be collected through the keeping of such records, the following record made by one of the Ayrshires at the Central Experimental Farm is worth reading.

FLAVIA II. OF OTTAWA.

This cow (see Plate 23) in her third lactation period, of 267 days, produced 9,364 lbs. milk, testing 4·417 per cent butter fat, equivalent to 486·60 lbs. butter, and netted a profit of $98.66, computed as follows:—

486·6 lbs. butter at 28c per lb.....	$136 25	
8,877·0 lbs. skim milk at 20c per cwt.....	17 75	
		$154 00
2,158 lbs. meal at 1¼c. per lb.....	$26 97	
12,719 lbs. roots and ensilage at $2 per ton....	12 72	
1,694 lbs. clover hay at $7 per ton.....	5 92	
2,420 lbs. green feed at $3 per ton.....	3 63	
1,050 lbs. straw at $4 per ton.....	2 10	
Four months pasture at $1 per month.....	4 00	
	55 34	
Total cost of feed including preparatory period from previous drying		55 34
Net profit		$98 66

Form 2.

DAILY MILK RECORD.

Herd belonging to .....
Post Office .....
Record for week ending .....

This form supplied free by Live Stock Division, Central Experimental Farm, Ottawa, Ont.

COWS.

Day.	Time.																						Total for Day.
Sunday	Morning.																						
	Evening.																						
Monday	Morning.																						
	Evening.																						
Tuesday	Morning.																						
	Evening.																						
Wednesday	Morning.																						
	Evening.																						
Thursday	Morning.																						
	Evening.																						
Friday	Morning.																						
	Evening.																						
Saturday	Morning.																						
	Evening.																						
Total	Week.																						

REMARKS:

(Reverse side of Form.)

CENTRAL EXPERIMENTAL FARM.

J. H. Grisdale, B.Agr., Director.

MILK RECORDS.

1. The profitable dairy cow must give over 5,000 pounds of milk each year. To know the value of a cow her total annual yield of milk must be known. The only way to know this is to keep a record of her daily milk yield.

2. The form on the other side of this sheet is intended to help progressive dairy farmers by supplying them with a simple and convenient sheet for the keeping of the milk records of their individual cows. A study of such records will soon indicate which cows should go to the butcher. We should be pleased to receive a summary of your record. If you have no summary forms write us.

3. Such records are being kept by hundreds of successful dairymen to-day. Many of these men attribute their success to the keeping of such records. Why not give the thing a trial if you are a dairyman? It will increase your milk product. It will lighten your labour, since your interest will be increased in your work and 'interest lightens labour.' It will show you the unprofitable cow, the 'boarder.' You cannot get rid of her too quickly.

4. For weighing the milk a simple legal spring balance may be secured for from one and a half to four and a half dollars. If your local dealer cannot supply you write the undersigned for particulars. A small platform scale is fairly convenient, but we find the spring balance preferable.

5. Many farmers keep records of the amount of food fed to individual cows. If you would like to do so, sample forms would be sent free on writing J. H. Grisdale, Director, Dominion Experimental Farms, Ottawa, Canada.

FEED RECORDS.

Much might also be said in favour of keeping feed records since to know really whether an animal is profitable or not, one must know not only the returns in milk and fat but must also know the amount and value of the food required to produce the same.

Forms, of the style illustrated below, are supplied free of cost to such as ask for them.

CENTRAL EXPERIMENTAL FARM, OTTAWA, ONT.

FEED RECORD FORM.

Herd belonging to ....For week ending..............
Address ....
Description of Mixture of Meal Fed.......................................

Cow.	Kind of Feed.	Quantity fed during day.							Total.
		Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	
	Meal.								
	Hay.								
	Ensl'g.								
	Roots								
	Meal.								
	Hay.								
	Ensl'g.								
	Roots								
	Meal.								
	Hay.								
	Ensl'g.								
	Roots								
	Meal.								
	Hay.								
	Ensl'g.								
	Roots								
	Meal.								
	Hay.								
	Ensl'g.								
	Roots								
	Meal.								
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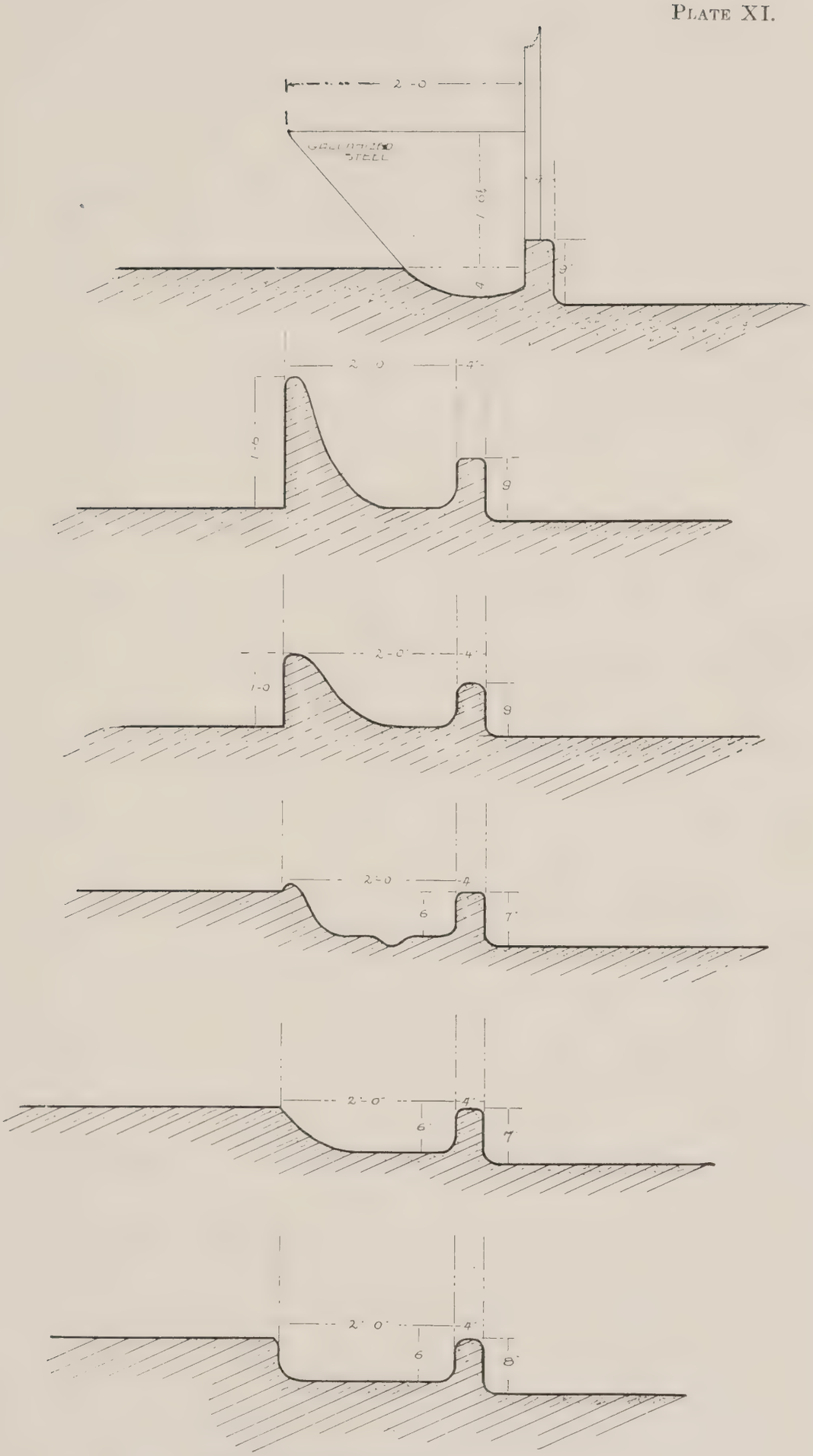
	Ensl'g.								
	Roots								
	Meal.								
	Hay.								
	Ensl'g.								
	Roots								



Some types of mangers for cow barns.

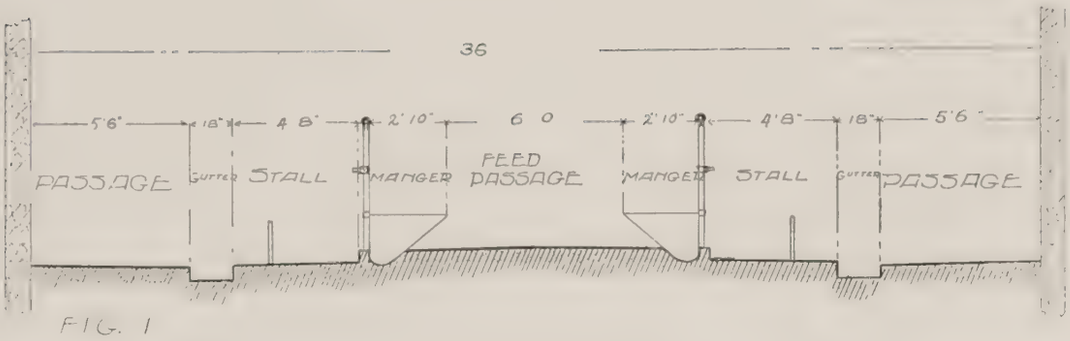


FIG. 1

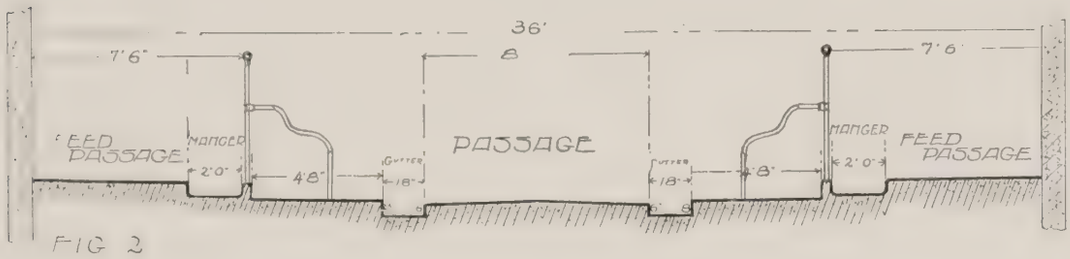


FIG 2

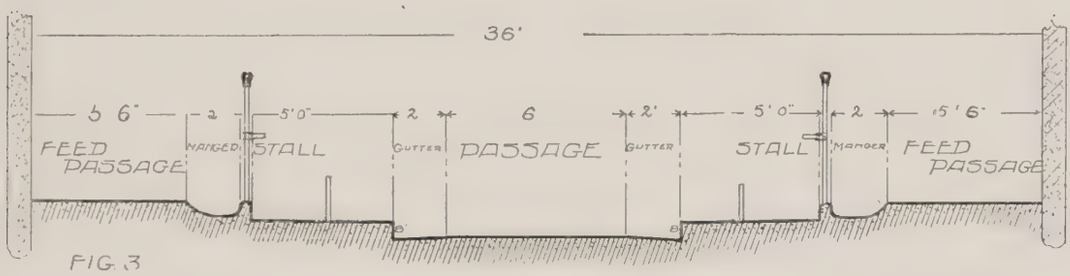


FIG. 3

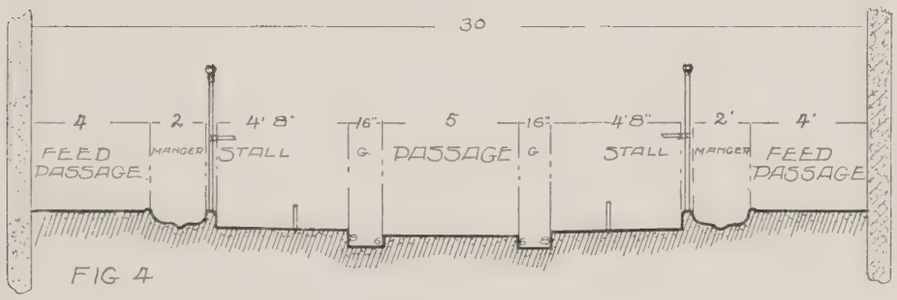


FIG 4

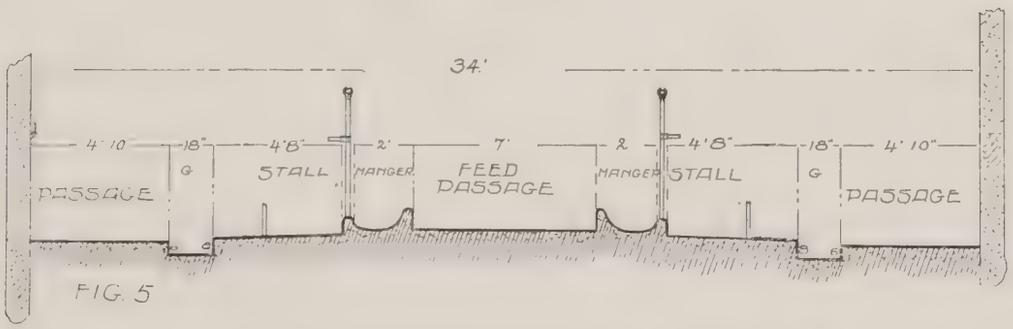


FIG. 5

Some sectional views of good cow barn floors.

PART III.—THE STABLE.

No two locations will require or even permit of the same treatment as far as exposure, size, form, or building material is considered in the erection of the cow barn and the remarks here presented are intended to be merely suggestive of certain principles of construction.

THE BARN A PERMANENCY.

The barn once built is likely to remain a long time on the farm. It will help to give character to the place, and may either have a pleasing effect upon the landscape and be a constant source of comfort and pleasure to its owner, or it may be an unsatisfactory eyesore quite out of harmony with its surroundings. It is as easy to build the one as the other if some thought be given the matter at the right time. The location must be studied, the surroundings noted, and the plans made accordingly. Whatever plan of barn be adopted, however, it should be placed with a view to convenience of access and with reference to other buildings which may be needed and built in the future.

Further, care should be taken to so locate the building as to permit of easy drainage.

The first problem to present itself is to decide whether the feed storage and the cattle shall be under one and the same roof, the feed above, the cattle below, or in separate buildings in more or less close proximity. After trying both plans and looking into many examples of both methods the writer is led to the conclusion that everything considered, 'the feed above, the cattle below' plan is the one to be recommended to the average dairy farmer. One condition, however, must be observed: the upper floor must be well ceiled beneath the joists.

The advantages claimed for the separate building plan, greater freedom from dust, more light, and easier ventilation, seem to be fictitious when carefully gone into. The advantages claimed for the 'under one roof' plan, economy in building, easy accessibility to feed, and lessening of labour bills are, on the other hand, stubborn facts impossible of refutation.

FLOOR SPACE.

Sufficient floor room as well as ample air space are conditions of comfort to both the cow and the owner too often neglected, either wilfully or ignorantly. The increased expense of having buildings roomy is the usual reason for cramped quarters. Roomy stables are likely to much more than repay extra cost of construction in increased returns and improved health of animals, to say nothing of added comfort and pleasure to owner. It is difficult to keep things right and get along comfortably with less than 50 square feet of floor space per animal housed. It is unnecessary, and in many parts of Canada unwise to allow over sixty square feet of floor for each animal included, cow, calf or bull.

CUBIC SPACE OR AIR SPACE PER COW.

From five hundred and fifty to six hundred cubic feet of air space should be allowed for each animal in the stable, and to accomplish this with reasonable economy of floor space, the distance between the floor and ceiling should be from nine to nine-and-a-half or even ten feet.

ARRANGEMENT OF COWS.

The best arrangement of cows is that which gives greatest convenience in feeding and cleaning. This convenience can perhaps be best obtained by having the cows in two rows the length of the stable with their heads toward the outside wall. Generally speaking, a passage of 5 feet wide at the head of the cows is recommended for the feed trucks. The passageway behind the cows should be sufficiently wide to allow of the easy removal of the manure and to permit the cows to move without danger in coming in or going out. About 7 feet is a good width for this latter passage.

The reverse arrangement, that is, a common feed passage instead of a common passage behind the cows, is often favoured. This arrangement, while fairly satisfactory, does not lend itself quite so readily to thorough ventilation and greatest convenience for milking and cleaning cattle. It is safe to say, however, that either arrangement will prove satisfactory and the plan likely to fit in best with the general arrangements for feed storage, feed preparation room, milk room and manure storage or discharge is the plan that should be adopted.

MANGERS.

The manger or feeding box should furnish each cow with a convenient place to eat, separate from every other cow and capable of holding her food in a position where she can reach it easily. It had better be constructed with a nearly vertical cement backing so that the cow will not, while eating the food nearest her, push the rest of it out of her reach. A continuous manger, 21 inches wide, with rounded bottom and from 6 to 10 inches deep, gives perhaps the best satisfaction inasmuch as close partitions separating each cow's portion can be arranged so that they can be raised, and the manger cleaned out. A slope toward one end and a pipe therefrom to the sewer permits of frequent washings. For different types of mangers se Plate 10. Any one of the forms illustrated as likely to prove fairly satisfactory.

TIES.

The method of tying cows is important. They should be fastened so as to have little chance for motion to right or left and yet have as much freedom of the head as is possible. This is best accomplished by the use of a good swing stanchion which permits the cow to turn her head easily from side to side and to move it freely up and down, but, withal, prevents her from interfering with her neighbours. The chain fastening is another good method, for while it gives the cow more opportunity to interfere with her neighbours, it allows her more freedom and permits easier lying down and getting up. Where chains are used, however, stall divisions are necessary to prevent horned animals from injuring each other.

WATER.

Water should be within reach of the cow at all times, and this is best accomplished by having small drinking fountains between the heads of each pair of cows. The supply of water to these drinking fountains can be controlled by a ball cock in a tank placed somewhere in the stable on a level with the fountains. Where a continuous cement manger is used for a row of cows it might be filled with water at intervals during the day and so obviate the necessity of fountains. Our experience here, however, would seem to indicate the separate fountain system as being the better plan.

LIGHT

The germicidal effects and the beneficent influence of sunlight are well known, and in the construction of a cow barn, arrangements should be made to admit as much light as possible. Windows should be as large and as frequent as the strength of the wall will allow. There should, if possible, be from 5 to 7 square feet of glass for each animal it is intended to keep in the stable. Windows should be so constructed that they may be easily opened or closed and should be protected with wire screens to permit of their being left open in summer without admitting flies. Double windows for winter are a great advantage in most parts of the Dominion. They not only prevent draughts where not wanted or needed but keep the inner windows comparatively free from frost and from the alternate melting off and freezing over so uncomfortable to man and beast and so effective in shutting out light when most needed.

WHITEWASHING.

As an aid in giving a bright, clean appearance to the interior of the cow barn and as an excellent hygienic practice, periodical whitewashing of the walls and ceiling cannot be too highly commended. As a wash for either inside or outside use, the following, if properly applied, will prove satisfactory:—

Half a bushel of unslaked lime, slake with warm water, cover it during the process to keep in the steam; strain the liquid through a fine sieve or strainer; add a peck of salt previously well dissolved in warm water, three pounds of ground rice boiled to a thin paste and stir in boiling hot; half a pound of powdered Spanish whiting and a pound of glue which has been previously dissolved over a slow fire, and add five gallons hot water to the mixture, stir well and let it stand for a few days, covered up from the dirt. It should be put on hot. One pint of the mixture will cover a square yard, properly applied. Small brushes are best. There is nothing that can compare with it for outside or inside work, and it retains its brilliancy for many years. Colouring matter may be put in and made of any shade, Spanish brown, yellow ochre or common clay.

FLOORS.

The floor of the stable should be laid out in cement and be so constructed as to be easily kept clean. Needless to say, cement

floors are much more durable than wooden floors and, if given a rough finish, there is little danger of hurt to the cows through slipping and falling. Planks may be laid over the cement in the stalls, but this is not necessary nor advisable where plenty of bedding material is available.

The relative levels of the different parts of the floor is a matter of considerable importance. A study of the diagrams on Plate will serve to indicate what is meant.

In the opinion of the writer the best relative levels are about as follows:—

Manure passage	6 inches above bottom of gutter.
	2 inches to 3 inches lower than rear end of stall or stand.
Gutter bottom	8 inches below stall or stand.
Stand	2 inches to 3 inches above manure passage and rising from 1 inch to 1½ inches in length from gutter to manger.

Division between stall or stand and manger 6 inches high.

Manger bottom	1 inch to 3 inches higher than stall or stand.
Manger back	Fairly steep and at least 6 inches higher than bottom.
Feed passage	To suit convenience or fancy; any one of positions indicated on Plate —— likely to prove satisfactory.

STALLS.

The length of the standing platform from manger to gutter, and its width, will of course be according to the size of the cows. From 4½ to 6 feet long by about 3½ feet wide is the size needed by dairy cows. Young stock and very small cows will require less space. A slope of from one to one and a half inches from manger to gutter will help keep the cows clean.

Where cows are tied by stanchion, divisions are not absolutely necessary between cattle. Generally speaking, however, it is advisable to have divisions of some kind on one side of each cow if not on both sides. This prevents undue crowding and turning in the stalls. Where chains or ropes are used, divisions are almost indispensable.

The more simple the division the better. A bit of 1½-inch iron pipe bent to enter the cement at right angles and to fasten to the dividing posts next the manger is probably the best sort to use. An examination of the various cuts and plans will convey a better idea of what is meant than a page of explanation.

FEED ROOM CONVENIENCE.

The feed room should be sufficiently large to permit of the preparation of the feed for the stock with as little inconvenience as possible. In planning the buildings it should be sought to have the feed room near the silos, the root shed and the meal bins. The floor should be of cement so that the feed may be mixed thereon. From the feed room to the stable the feed can be conveyed either by trucks or by an overhead feed carrier. A scale should be provided to weigh the feed as dispensed.

CARRIERS AND TRACKS.

The removal of the manure from the stable and the transportation of food from feed room to cow are matters of no small consequence in large cow barns. The principal considerations to be kept in mind when attempting to decide upon the system most likely to prove satisfactory in any given barn are: Width of passages, cleanliness, economy of labour, speed, durability, and amount of disturbance likely to accompany cleaning or feeding operations when carried on by the particular system introduced.

For removing manure it is probable that, where space will permit, using the team and manure spreader will prove most satisfactory. Where space is very limited, some overhead track system would probably be the best to install. Where space allowance is fairly liberal, however, the large, water-tight wheel barrow is, in the writer's opinion, the best carrier to use from the standpoint of cleanliness, speed and economy of labour.

For carrying the feed, the truck on three wheels is, according to the writer's rather extensive observations and careful study of the question, easily the most satisfactory system from the standpoints of economy of labour, cleanliness, convenience, disturbance of cattle and low cost of maintenance.

BOX STALL ACCOMMODATION.

The stalls and boxes for calves, bulls, sick animals, or for any other purpose, should be in a building adjacent to, but if possible

divided from, the stable where the milch cows are kept. This building should be as well built, as carefully ventilated and as well lighted as the cow barn. For calves, either stalls with small swing stanchions, or boxes, should be provided. These would, necessarily, vary in dimension to suit the different sizes of calves.

Box stalls for bulls should be 10 feet x 10 feet or larger, built with walls sufficiently high to prevent the inmates interfering with other animals, and with a window in each for a good supply of light.

The boxes for calving cows and other sick animals should be in the quietest part of the stable, and, if possible, in a place partitioned off from the rest. It should be arranged so that abundance of light and air may be admitted, but with ready means for the control thereof.

VENTILATING THE COW BARN.

The absolute need for pure air in our stables of all kinds is to-day conceded by practically every stockman. Yet only once in many visits does one find things right. The causes of imperfect success where efforts have been made are various. One of the most common is failure to give proper attention to the system installed. Another often met with is imperfect installation. Ignorance of what good ventilation really is, however, accounts for the most failures of all.

To spend good money and careful thought installing a ventilating system, only to neglect keeping it in operation is criminal. No effective system ever devised for use in stables is automatic in adjustment to varying atmospheric conditions. Changes in temperature or variation in wind velocity will always necessitate some change in the arrangement of the controls or checks.

Neglect to open or increase the capacity once it has been cut off in some measure in a cold time, is the most common cause leading to the condemnation of what might otherwise have been a good system. Another quite frequent cause leading to the condemnation of a system is the too small capacity of the installation. The average carpenter is apt to guage the requirements of the stable in the way of air by the coldest weather requirements. For this reason, installations are very apt to be too limited in capacity for average weather conditions and much too limited for warm weather.

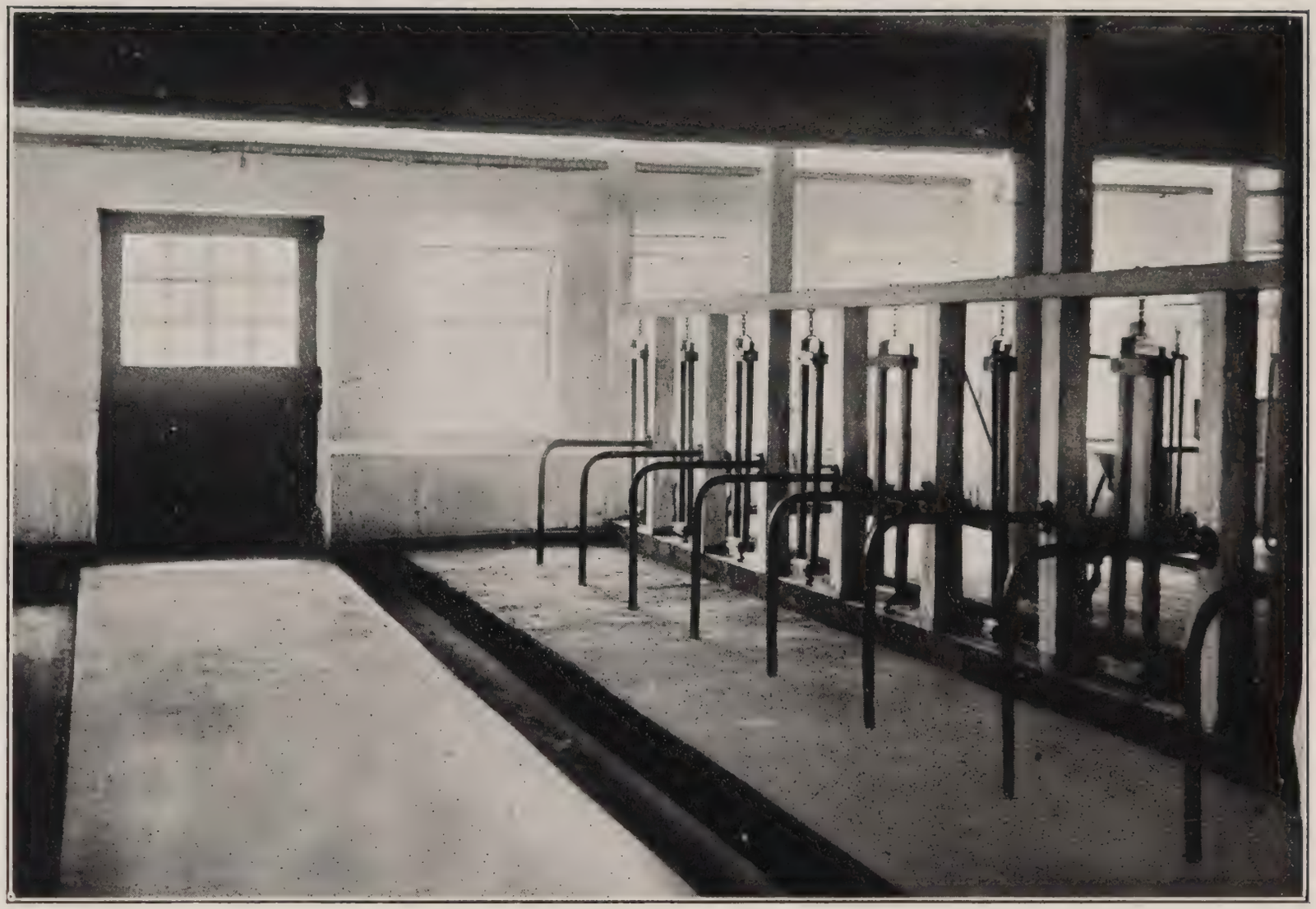
Then again, an installation may be condemned unfairly, because the owner of a stable expects it to do more than any system of

ventilation could ever do. A common standard by which the effectiveness of a system is judged is its ability to keep the walls and ceiling free from moisture. This is frequently a most unfair test. Precipitation of moisture on walls or ceiling is due to the warm vapour or water-charged exhalations of the animals, rising and lying for too great a length of time in contact with the cold wall or ceiling as the case may be. If the construction of wall or ceiling be faulty, as for instance, where only double boards with paper between constitute the same, then no system of ventilation could keep them dry without lowering the inside temperature to practically the same as the outside. Walls possible of being kept fairly dry must have more or less insulation, that is, a dead-air space or a concrete core, or shavings, or something to prevent too rapid conduction of heat. Then with a fairly rapid circulation of air the walls and ceiling may be kept dry. A ceiling protected by straw or hay overhead is the most satisfactory.

Walls with a dead-air space may usually be kept dry fairly easily. Stone walls or solid cement walls must be lined to insure their being fairly dry. No system of ventilation would otherwise ever keep them dry in very cold weather.

The number of cattle in a given cubic space is quite an important factor making for the effectiveness of any system. Too many cattle makes it difficult to ventilate in such a way as to avoid draughts, too few makes it impossible to keep the temperature up to the comfortable point and at the same time provide for sufficient air circulation. Low temperature does not always mean pure air, and here is a point where a great many stablemen make a mistake. The air in a stable where the thermometer shows several degrees of frost may quite easily be most vile. From all which, it seems important, in the first place to so arrange matters that there shall be about the right number of animals in the given stable, allowing, say, from 600 to 800 cubic feet of air space for each cow two years old and over. This condition existing, there should then be provided about 15 square inches or more of controlled outlet area and about 8 square inches or more of controlled inlet area for each animal in the stable. For instance, a stable 36 x 30 x 10, which might be expected to accomodate 18 or 20 head, should have an outlet about 18 inches square or 20 inches in diameter, if round, and the inlets should be at least 6 inches by 12 inches and two in number.

Interior Cow Barn, Ottawa.



Interior View, Main Cow Barn, Ottawa.

Note.—Abundant light; large gutters; simple divisions; swinging stanchions; floor levels.

By controlled inlets and outlets is meant that it should be possible to cut off the whole or any part of the inlet and outlet by means of some kind of damper or key.

The controls are necessary for the reason that very cold air being a great deal heavier than warm air compels a very much more rapid circulation or inflow and outflow of air in very cold weather than in warm. This must be controlled or temperatures will fall too low in cold weather and rise too high in warm weather.

The dimensions of shafts or outlets and inlets given above, allow for friction of air currents in the shaft, for, while 8 to 10 square inches per head in outlet area might be sufficient in very large stables, the same relative area in a small stable would certainly be found faulty. Outlet shafts must be neither too small nor too large. Where materially exceeding the area per head given above, they are likely to work unsatisfactorily and to be constantly dripping in warm weather and freezing in cold, due to the air currents being too sluggish. Where less in area by any considerable amount, they are sure to be wet and dripping practically all the time and to carry impure air off too slowly.

Many systems of ventilation have been devised and advocated. The perfect system has not yet been thought out. It is, besides, practically certain that a system capable of operating satisfactorily under any set of conditions that might be imposed never will be constructed. During the last ten years, the writer has tested out some thirty or forty different schemes, systems or devices for ventilating farm buildings such as cow barns, horse barns and piggeries, and has, during that time, learned two things very thoroughly. These two items of information well-learned are:—

(1.) Good ventilation is a necessary and very profitable feature of any stable.

(2.) No known system of ventilation is absolutely automatic or faultless.

It has also been possible to come to some conclusion as to the relative merits and adaptability of the various systems tried out. Many systems have shown more or less effectiveness, but of the thirty and odd systems experimented with, I may say that the system commonly known as the Rutherford System of Ventilation has proven much superior to any other tried. The superiority of this system is due to various features, the chief being:—

(1.) Ease in installation, in buildings old or new.
(2.) Adaptibility to all classes of stables.
(3.) Suitability to variety of weather and climate.
(4.) Facility of operation and control.
(5.) Effectiveness in control of temperature in all parts of stable.

As just stated, it is susceptible of easy introduction into old stables and may be readily and conveniently installed in new buildings. A study of diagrams given below will show probably the best relative positions for inlets and outlets. There is, however, but slight objection to any number of other possible or necessary different arrangements.

Diagram A, showing floor plan of a stable for, say, 26 cattle, also illustrates probably the best relative positions of fresh air intakes A A A A and foul air outlets B B (beginnings of shaft in ceiling, see W D, diagram B). This arrangement suits where nothing in the use to be made of loft or superstructure interferes in any way.

If a horse fork is to be used in the superstructure, then it might be necessary to change positions of B B to C C where shafts would need to be constructed as shown in Diagram B by dotted lines W^1 G D. The fact of the outlet shaft changing directions at G and D will not interfere materially with its efficiency. These outlet shafts, provided they are staunchly built as described further on, may take almost any desired course so long as it is always more or less upwards.

The area indicated, 1 foot x 2 feet each, or 4 square feet for the two outlet shafts, is somewhat greater than is really necessary but it is much better to have shafts slightly larger than any smaller than the minimum of 15 square inches per cow mentioned above.

The intakes A A A A might, if necessary, be changed to pass under or through walls at D D D D, say 7 inches x 12 inches. This new arrangement would be advisable in case outlet openings had to be placed as C C.

In the intakes, fresh air enters at 1, passes under wall and enters stable at 2, with an upward tendency. The wall, 3, should be about 6 inches thick and on this wall should be built the little guard shown at M in Diagram B. The inner wall corresponding to 3, need not be over 4 inches thick.

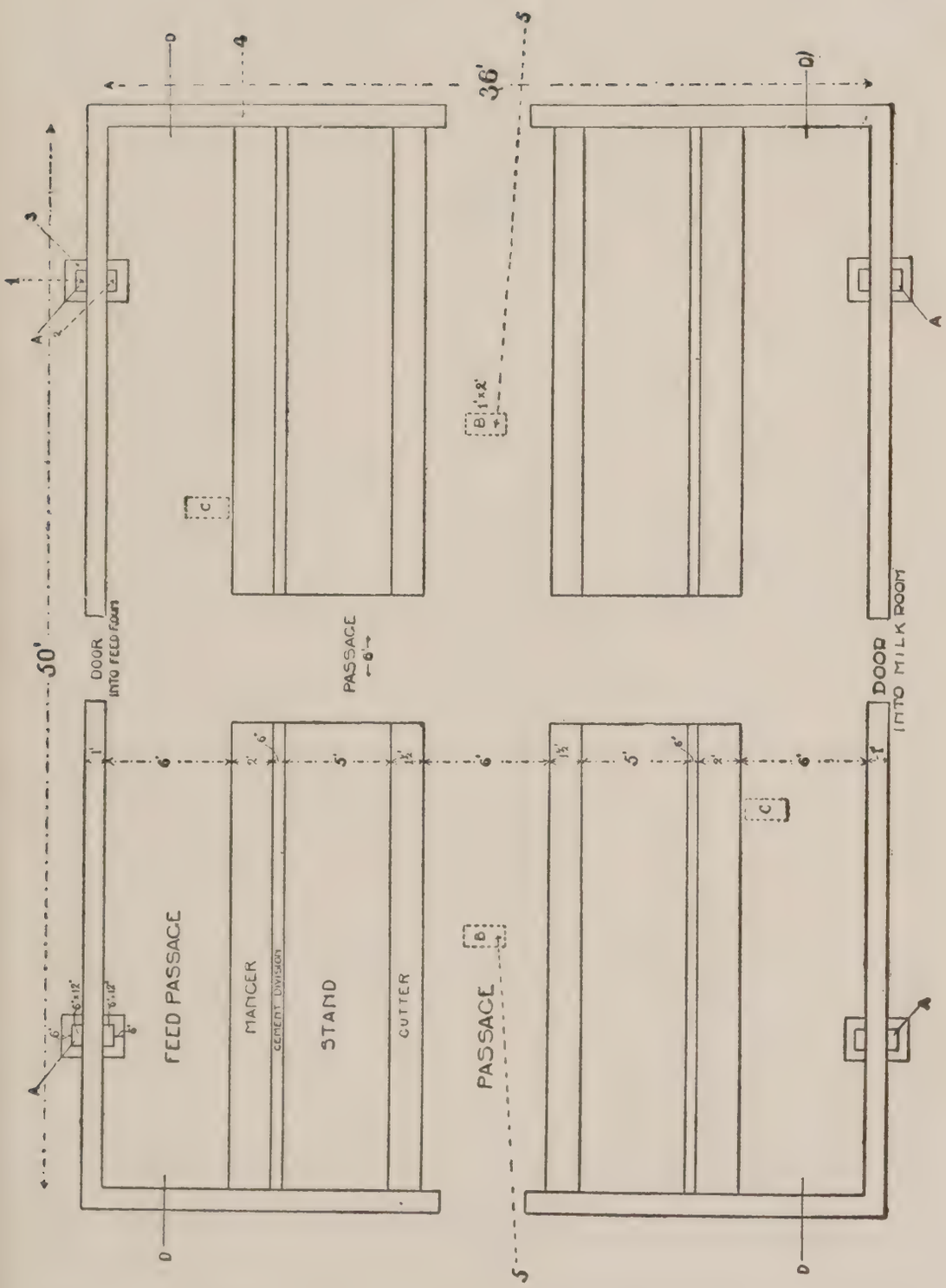


DIAGRAM A.—Floor arrangement of Dairy Barn, showing Stands, Passages and Ventilators.

Diagram B, showing a stable in cross-section, will indicate the best method of building walls and ceiling and also illustrates two different methods of introducing the fresh air in the Rutherford System. There is very little to choose between these two methods;

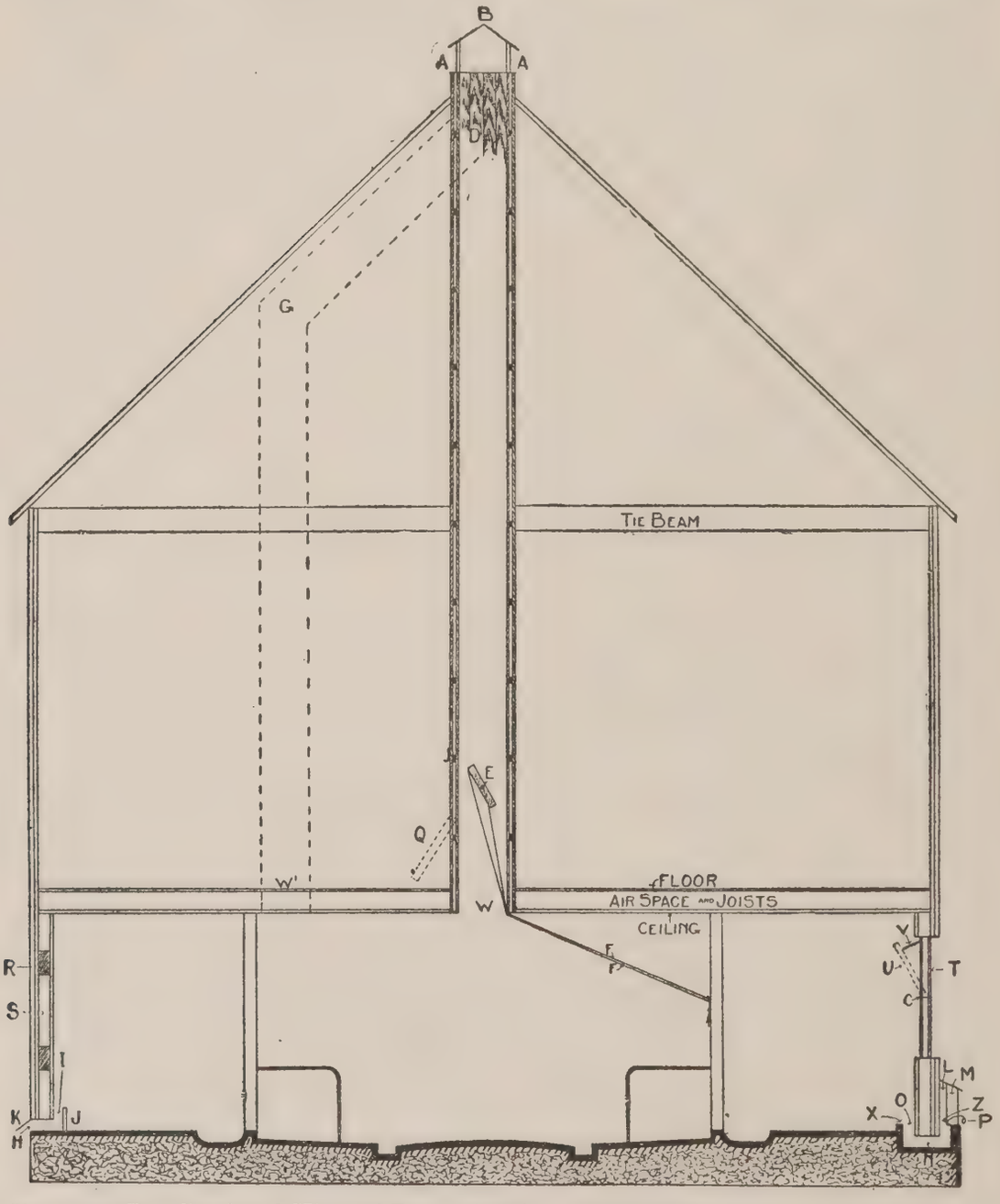


DIAGRAM B.—Sectional View of Barn, showing Rutherford System of Ventilation

that on the left is somewhat more cheaply installed and can be introduced at any time, while the method on the right is probably somewhat more effective, slightly more expensive and must be installed when the building is being erected. The following explanatory paragraphs will help to a full understanding of the features illustrated.

The outlet shaft for foul air, W D, should be in duplicate and should be about 1 foot by 2 feet inside measurement. The best construction is boards running vertically, two ply with inch airspace and two papers between. The opening at the top should be roofed, (see B). The roof should be supported on four posts, AA, leaving a clear space about 15 or 16 inches between top of shaft and bottom of roof B. The amount of air to escape by these shafts in any given time may be controlled by means of a key as at E. The key may be regulated by cords F F. The key should never be entirely closed. Where the shafts are large enough, there is no objection to their being used as chutes for feed or litter, but care should be taken to so hang the door as to insure its remaining tightly closed when not held open to allow of shaft being used as a chute.

The fresh air inlets require careful consideration. The method on the left is very simple of installation. The passage through from K to I should be about 12 inches by 7 inches, the greater dimension being horizontal. K is a protection or roof, H the intake, I the outlet into the stable through which the air passes with an upward tendency. J is a guard or board so placed as to direct air currents upwards. To do this, it will need to extend about 4 inches above top of opening through wall. It will, of course, be nailed to the projecting 7 inch sides of this fresh air shaft inside the building, just as K will be nailed to the same sides outside the building. These passages might be controlled by means of small keys or hinged covers, but it is not usually necessary or advisable to so control the intake shafts.

The method on the right hand side admits air by the passage N, 12 inches x 7 inches below the level of the floor. Air enters this passage at L under shelter of the snow and rain guard M and flows into the stable at O, with an upward tendency. The cement or wooden guard X is to prevent dirt or dust being knocked or swept in. The top or opening should be protected by a grating of some description. It is possible, but seldom necessary or advisable, to provide these inlets with keys or controls. If it is found necessary to use some system of control, then the control Z had better be outside the building but inside the guard cabin M where it can be regulated by a cord passing out at P.

The careful installation of this system of ventilation, with either method of fresh air intake, will insure an abundance of good

fresh air at all times, provided it is allowed to operate. If, however, it is left to the mercies of the average hired man, it, like any other system, will be found useless.

To get best results in ventilating any stable and to insure a comfortable, dry building possible of being kept well ventilated, clean and hygienic, attention to the following small details in construction will be found very helpful.

1. Use simple fixings. 2. Ceil under joists. 3. Put in all the windows the superstructure will permit. 4. Let windows be high. (See cut). 5. Hinge windows in middle at C. 6. Use chains as at V to allow them to open inwards at top. 7. Provide double windows for winter. 8. Walls should be built to include air space. Starting from the outside inward, the following will be found satisfactory: Battens R, inch dressed lumber, two tar papers, studding 2 x 6 and air space S, two tar papers, V-joint.

PART IV.—THE PRODUCT—MILK.

Milk is an opaque, whitish liquid secreted by female mammalia for the nutrition of their young. In the case of the cow, and some other animals used to supply milk for human consumption, the function of milk production has been so developed by breeding and selection that the yield is much greater than is required for the sustenance of their young. The length of their period of lactation has also been increased much beyond the time that the young would be dependent upon the mother's milk.

The processes of the elaboration of milk are not very well understood. The seat of secretion is however undoubtedly in the mammary glands, though some believe that the water and some of the soluble compounds are derived by direct filtration from the blood.

The udder is not merely a reservoir for the milk between the time it is manufactured and drawn. Indeed it is evident that a great part of the milk is made during the actual operation of milking, as is shown by changes in quality and quantity resulting from any unaccustomed action, such as quick instead of slow milking, or a change of milker.

Milk is a food, and, of all foods, comes nearest to meeting all demands of the body. It is, in fact, a complete food for the young. Its constituents in their proportions in average milk are as follows:—

Constituents.	Quantity. Per cent.
Water	87·0
Ash	0·7
Albumen	0·7
Casein	2·6
Fat	4·0
Sugar	5·0

In analysis these are spoken of as water and milk solids, the latter comprising the ash, albumen, casein, fat and sugar. The solids again are divided into 'Fat' and 'Solids, not fat.' Milk standards are fixed by Provincial Statute in Canada hence no uniform Canadian standard may be said to exist, but it usually requires that there be no more than 87·5 per cent water, that the total milk solids shall make up at least 12·5 per cent, and that there be at least 3 per cent fat.

COLOSTRUM.

The first milk after parturition is usually thickish and bloody or orange-yellow in colour. This milk is laxative in effect and should be given to the calf. It is not usually used as human food and where milk is being sent to factory or city, that from the newly calved cow should not be included in shipment until after the third day from parturition.

PRESERVATION OF MILK.

In the process of milking a greater or lesser number of bacteria find their way into the milk. While some of these are not harmful, the greater number are and the dairyman's aim, as soon as the milk is drawn from the cow, should be to make conditions for the growth of these as unfavourable as possible.

The temperature at which most of these organisms grow best, known as their optimum temperature, is about 95° F. which is a little above the temperature of milk as it comes out of the udder. As soon, therefore, as the milk can be cooled down to a temperature which does not favour the growth of these organisms—45° to 50° F.—the better it will be.

The methods of cooling down are many and varied, and must necessarily be according to the conveniences of the place. One of the best methods is the use of a tank containing iced water. As soon as taken from the cow, the milk is placed in a can standing in the water in this tank and then covered at once. Care has to be taken that the level of the water on the outside of the can is higher than the level of the milk within, else a layer of milk at the top will not be properly cooled. If there is a great quantity of milk to be cooled, the water may have to be renewed, or it may be kept cool by placing within the tank a block of ice.

Whatever method of cooling is adopted, care should be taken to have it done in a clean, sanitary building which is apart from the cow shed, and remote from any offensive odours which might be readily absorbed by the milk. It is only by properly cooling the milk to a temperature at which the unfavourable organisms cannot grow, and doing it in a clean sweet place, that milk can be kept for any length of time and put on the market in good condition.

MILK UTENSILS.

Ease of cleaning is the first requisite of milk utensils, and in this regard there are several things to be considered. In the first

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Milking Time, Main Cow Barn, Ottawa.
Note.—Small-mouthed pails ; clean cattle ; clean stable ; clean men.

Milking by Machinery.

The milking machine in operation at the Main Barn, Experimental Farm, Ottawa.

place, metal utensils are always preferable to wooden, since wood readily absorbs milk particles and is thus very difficult to keep sweet and clean. In purchasing metal utensils, care should be taken to see that all are heavily tinned for, unless they are, the tinning will soon wear off and a chemical reaction will set up between the milk and the iron. The compound so formed, if present in sufficient quantity, will cause a greenness in cheese made from this milk. The wearing out of the tinning also makes for greater difficulty in the keeping of the utensils clean.

There should be as few seams and crevices as possible for these are difficult to keep clean and give lodgment to dirt and bacteria. It is possible now to buy 'stamped' pails without seams or crevices. If such pails are not procurable, care should be taken to see that all seams in pails in use are filled and flushed with solder. The bottoms of all vessels should be concave rather than convex, thus doing away with the crevice which is so often found all around, and which cannot be cleaned properly.

The mouths of cans should be wide enough to permit of easy cleaning; all lids should fit tightly and should be provided with a shoulder to overlap the mouth of the can.

CARE OF UTENSILS.

As soon as possible after milk has been removed from utensils they should be washed. First, a rinsing with tepid water to remove the milk particles should be given, to be followed by a thorough washing in hot water to which washing soda has been added. The scrubbing brush should be freely used here especially in any corners which the vessel may have. To finish, a scalding in boiling water, or, better still, a good steaming over a steam jet should be given. After this, the vessel may be placed in a sunny, airy spot, free from dust and dirt and remote from bad odours.

Where milk is conveyed to a creamery and whey taken back, the same cans should not be used for both purposes. It is almost impossible, even with the greatest care, and the best conveniences, to get rid of the organisms which are most likely to be present in the by-product.

THE SEPARATOR.

The purpose of a separator is to remove the cream from the milk, and this a good separator will do almost completely if pro-

perly managed. The old-fashioned method of skimming leaves sometimes as much as 25 per cent of the cream in the milk. Another benefit derived from the use of a separator is that the skim-milk is still warm after the cream is removed and can be fed to calves or other animals in this condition with best results.

In the choice of a separator there are one or two things to be considered, of which ease of cleaning is perhaps the most important. The more pieces of intricate mechanism there are in a separator the greater will be the difficulty of cleaning, and so simplicity of construction combined with efficiency of working is essential. In addition to this, ease of running and durability are deserving of consideration

BY-PRODUCTS.

In some parts of the country, the farmer ships the whole of his milk supply to the nearest city or cheese factory. If to a city, there is no return of by-product, and the whole of the valuable constituents of the milk is lost to the farmer. If, however, the milk is sent to a cheese factory, the farmer frequently is able to take back some whey which contains many of these constituents in almost their original quantities.

If, however, the farmer uses a cream separator and ships only his cream, or better still, if he makes his cream into butter on his own farm, there is practically no loss of fertility for 'selling butter is selling sunlight.' Where the farmer makes his own butter he has two by-products in skim-milk and butter-milk, both very valuable in the feeding of animals.

Of milk there are thus three by-products, skim-milk, butter-milk, and whey. Skim-milk, as is stated elsewhere in this work, is a valuable feed for calves, pigs, and other classes of stock, its content of ash and protein being especially valuable in the nourishment of growing animals.

Butter-milk also is rich in ash and protein and is very much valued as a feed for young pigs.

Whey, if returned to the farm from the factory, brings back very much of the mineral matter contained in the original milk. For pigs, and even, when fresh and sweet, for calves, whey makes a valuable addition to the ration.

MILKING.

The cows should be milked regularly at the same hours every day, and these hours should be separated by periods of as nearly equal duration as possible.

Cleanliness.—Before beginning to milk, the milker should wipe the sides and udder of the cow with a clean rag moistened with fresh clean water. This has the effect of causing loose hairs, dust or bacteria to adhere to the animal, and so they do not fall into the milk pail. The first few streams of milk should not be drawn into the pail for the content of harmful bacteria therein is usually large. Milking should be done with clean, dry hands, and dry teats, and the milker should wash and dry his hands after milking each cow. This, besides keeping his hands clean, prevents the spread of any disease, such as sore teats, from one animal to the other. In short, the utmost cleanliness should be exercised by the milker in the care of the animal, of the milk dishes, and of himself.

The milking should be done as rapidly as possible, though care should be taken that it is done evenly, so that the temper of the cow may not be disturbed.

Periods between Milkings.—As already indicated, the periods between milkings should be as nearly equal in length as possible. It may be stated, however, that experiments conducted here show that, where cows are milked only twice a day, as is the usual practice in Canada, a considerable deviation from this general recommendation may be made without any appreciable effect upon the result in a given period of, say, a couple of months' duration. This is true, of course, within certain limitations, thus, while milking at ten and fourteen-hour intervals might be expected to prove satisfactory, milking at six and eighteen-hour intervals would very certainly prove injurious in effect.

It should be noted, however, that what is true is this respect about a 30 or 40 pound-a-day cow is not likely to be true with the 50 to 60 pound-a-day cow and even much less so in the case of very heavy milking cows yielding, say, 70, 80 or 90 pounds a day. In fact, it is practically certain that no cow would ever reach 80 or 90 lbs. of milk a day, if the milking were being done only twice in 24 hours.

Variations in Quantity and Quality of Milk.—It should be observed that the milk yielded by cows milked at unequal periods, but at regular hours, is likely to vary in quantity proportionately

with the length of periods but to vary inversely as to quality of milk. This might be better explained by saying that, while cows yielding 30 lbs. of 4 per cent milk, or 1·20 lbs. butterfat, and milked at 6 a.m. and 6 p.m., might be expected to give about 15 lbs. of 4 per cent milk, night and morning, the same cows milked at 6 a.m. and 4 p.m. would quite probably continue to give 30 lbs. of milk in the 24 hours but would generally produce the milk and butterfat about as follows: At 6 a.m., 17 to 18 lbs. of 3·5 to 3·75 per cent milk and at 4 p.m., 12 to 13 lbs., of 4·3 to 4·6 per cent milk.

We have demonstrated, too, that not only may the quality of the milk produced by any given cow vary from milking to milking in a fairly regular way, but it may vary materially from day to day as affected by a multitude of minor influences, such as variations in weather, supply of water and salt, change in quality of food or of method or time of feeding, change of milkers or time of milking, fear, anger, uneasiness or discomfort in any form.

Further, as any dairyman soon learns, the quality of the milk improves as the actual milking operation progresses. The first milk drawn is invariably low in butterfat. As the operation progresses, the percentage of fat increases until the highest fat content is reached in the last few ounces that can be drawn or coaxed from the udder. *Moral, milk your cows clean.*

MILKING MACHINES.

Milking machines have been in use for many years. A machine in use in the main barn here has proven very satisfactory. It can be kept perfectly clean with a moderate amount of labour. It has not, apparently, any tendency to decrease the milk yield of the cows. The milk drawn by the machine is, on the average, about as clean as that drawn by hand.

While it cannot be said, everything considered, to do the milking much more cheaply than it can be done by hand, it has the advantage of making it possible to milk a large number of cows in a reasonably short time with a small number of milkers. The work of running the milking machine seems to be more acceptable to most men than is hand milking.

The machine may be operated by steam, gasoline or electric power. One man can run from three to four milking units. Each unit draws the milk from a single cow and draws it quite as quickly, if not even more quickly, than it can be done by a rapid milker. It

is too soon yet, however, to permit of making a definite pronouncement on this rather vexed question.

CARING FOR AND HANDLING THE COW IN MILK.

The quantity and quality of the milk produced depends in large measure upon the methods of caring for and handling the cow in milk. Comfort and quiet in her surroundings, kindness and cleanliness in handling are the certain conditions of success and profit in the cow business.

LITTER.

Comfort means good stalls well bedded. Almost any dry absorbent material will answer for bedding, clean, dry sawdust and straw being among the best. The supply of these should be renewed with more or less fresh material every day so that the dust which is likely to gather in old bedding may be kept down.

BRUSHING.

When at pasture, the hair of the stock is kept clean by wind and rain, and very little grooming or brushing is necessary. Some time before milking, however, they should be rubbed down so that the dust and loose hairs may be removed and will not fall into the milk pail. In winter, when the cows are confined to the stable, the waste thrown off by the skin must be removed in order that the skin secretions be not interfered with. This is best done by currying and brushing, which, in winter, should be a daily operation.

WASHING CATTLE.

Washing cattle is a custom not generally followed except in the case of cattle being prepared for the show-ring. Where the cattle are properly groomed—curried and brushed—washing is perhaps unnecessary, and is too great an undertaking to be practicable. Sometimes, however, a cow coming in from a muddy road or field may be so dirty that washing seems the only way of getting her clean.

CLIPPING.

As an aid to cleanliness, clipping either the whole body of the cow, or at least the hind flanks, the udder and the inner and outer thighs, will be found advisable. The actual operation of clipping takes but little time and the saving in time needed to keep the cattle clean will pay for it in a week, to say nothing of the almost certainly better quality of the milk produced.

Our practice is to clip the whole body. This, while involving some expense to begin with, has, we consider, in the long run, proven by far the cheapest help in keeping cattle clean.

KINDNESS IN TREATMENT OF COW.

Kindness is an efficient aid in increasing milk yield and costs nothing. The more a cow likes a milker, the more milk she will give him. Investigations show that it is probable that a considerable portion of the milk is secreted during the operation of milking, especially the rich milk which comes last. Abuse and excitement reduce the secretion and not only lower the quantity of milk yielded, but often lower the percentage of butter fat. Kindness makes the cow contented and puts her nervous system in such a condition that the fullest yield is given. Hurrying cows, running them with dogs, beating them or speaking roughly to them, will reduce the quantity of milk and percentage of butterfat. A change of milkers will often lower the quantity and quality of the milk until the cow becomes accustomed to the new milker. For this reason, it is usually advisable in large stables, where milkers are sure to be changed from time to time, to so arrange matters that no particular cow is milked for any considerable number of days by any one man. A good plan is to start the first milker at the first cow, then take the cows in order as each man is ready for a new one.

SUMMARY.

To condense the above remarks, it might be said that proceeding according to the following suggestions will do much toward insuring 'clean milk' being produced in any even fairly well-arranged stable.

1. Do not disturb manure for at least one hour previous to beginning milking.
2. Do not feed dusty feed or scatter dusty bedding for some considerable time before milking.
3. Ten minutes before milking, clean off all dust from cows to be milked.
4. Just before milking, rub right flank and udder with a damp cloth.
5. Draw first two streams from each teat into separate pail.
6. Use narrow-mouthed pails.
7. Wash hands after milking each cow.

8. Milk with dry hands or else use vaseline. Never moisten fingers with milk.

9. Milk rapidly but smoothly.

10. Talk in low tones, if at all, and do nothing else to disturb cattle.

11. Strain milk through three or four plies of cheese cloth as well as through a fine wire screen into larger receptacles.

PART V.—FEEDING FOR MILK.

GENERAL NOTES.

AN ABUNDANCE OF FOOD NECESSARY.

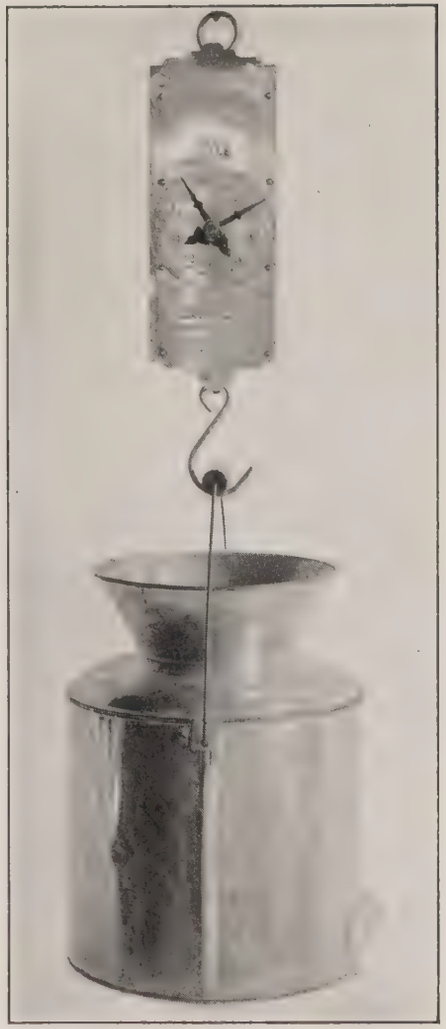
Where the herd is made up of the right kind of cows, the quantity and quality of the feed consumed is, up to a certain point, the measure of milk production. Underfed cows, as every farmer knows, yield small quantities of milk, usually, if not always, at a high cost per unit for even the small quantity produced. Yet it is safe to say that in Canada seventy-five per cent or three-quarters of the cows in milk do not receive enough feed to enable them to reach what might be described as the maximum of production at the minimum of cost. 'The largest quantity of milk and butterfat at the lowest feed cost per pound milk or butterfat produced' should be the aim of every dairyman.

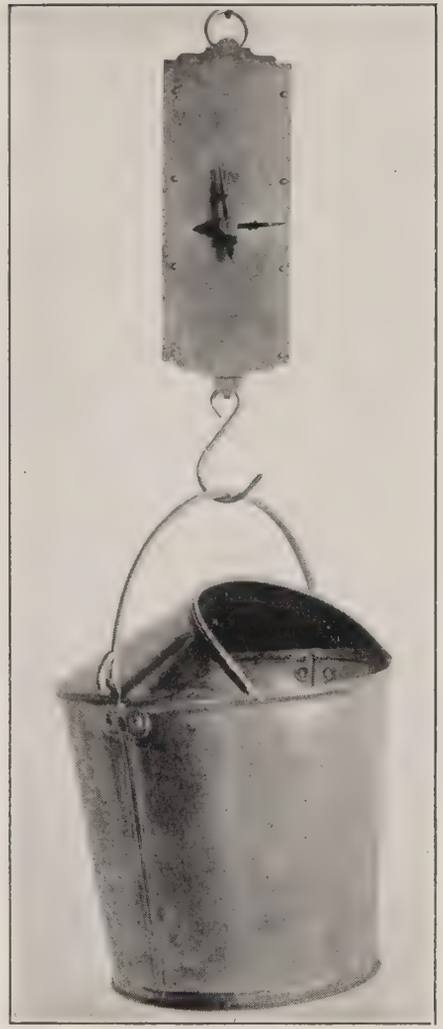
Many under-fed dairy cattle are also badly-fed dairy cattle inasmuch as the ration provided is frequently unsuited for the end in view—milk production. It is not, however, among the under-fed alone that the badly-fed cows are to be found since many farmers, sufficiently large-hearted to feed a generous ration, fail to appreciate or are ignorant of the importance and economy of combining the different feeds in the right proportions to insure the best returns in milk. Such a knowledge of feeds as will enable the feeder to prepare the best ration at the lowest cost is not very easily gained but the careful study of the following notes and a little experience will go far toward making even the veriest beginner an effective and economical, that is to say a skilful, feeder.

CHANGING FROM STALL TO PASTURE.

Sudden changes from one feed to another should never be made, as they, in most cases, decrease the flow of milk, even when the new ration is better than the one to which the cow is accustomed. When a change is necessary it should be gradual, extending over a week or ten days.

The young, immature grasses, especially in early spring, as is well known, contain a large amount of water, a condition commonly called 'washy.' Wheat and rye pastures are of the same nature, and when the cows are about to pass from the dry feed of winter to the succulent feed of summer, great care is needed. At first they ought





"Weighing the milk." Note :—Dial face scales. Several types of pails.

A German-made milking pail. A Strainer. "The Milking Hod." Small-mouthed pails mean clean milk.

to have a feed of hay before they leave the cow house for pasture and only be left at grass a short time. Then day by day the hay may be diminished and the length of time at pasture increased until at length they may be allowed to pass all the time at grass. It does not pay, however, to turn dairy cows to pasture in the spring until the grass furnishes good feed, *i.e.* until it has a good growth.

PASTURING.

On most Canadian farms, pasture grass forms the main food for the dairy cow in summer. Pasture grass in right condition is a perfect food and when the animal can secure sufficient of it, without too great effort, maximum milk yields may be expected. Clover and alfalfa pastures give best results, but our natural grasses as they grow in rough places on hill sides, etc., are very valuable as feeds for milk production.

At the Central Experimental Farm the following mixture of seed per acre for seeding down and pasturing has been found to be very satisfactory: 5 lbs. red clover; 2 lbs. alsike; 7lbs. alfalfa; and 10 lbs. timothy.

Pastures should not be used till the grass stands several inches high and, in the case of clovers and alfalfa, it should be a foot high before cattle are turned in. Much better results may be expected in the way of feed from a given area if it be divided into two, or even better, into three parts and the parts pastured for a few days in turn. Closely cropped grass grows slowly and suffers much more quickly from drought and trampling than does longer, stronger grass.

FEEDING MEAL TO COWS AT PASTURE.

Opinion is divided as to whether it is profitable to feed meal while the cows are at pasture, but the weight seems to be in favour of feeding meal, for while perhaps no improvement in quality nor increase in quantity of milk results while the pasture is at its best, yet when the pasture begins to fail, the animals are better able to keep up to their flow. It is doubtful, however, if it would be economical to feed meal where there is an abundance of nutritious grass, for the increase in quantity of milk from such feeding may not, unless the price of dairy products be very high, justify the extra expense.

While the pasture is abundant and of good quality, the quantity

of meal fed need not be great. One to two pounds per day would be sufficient; whenever the pasture begins to fail, however, the meal ration will have to be relatively increased in order to avoid a drop in the milk flow.

As can be readily understood, meals or meal mixtures most suitable for feeding to cows in winter quarters and on winter feeds are not necessarily the best for feeding to cows on grass. Mixtures of equal parts oats, barley and peas, or of oats, barley and bran, or of oats, corn and peas, or of oats, corn and bran will be found satisfactory.

SOILING.

Drought and the hot sun of summer very quickly injure pastures; and after about the latter end of June, as a rule, recourse must be had to something else to keep up the flow of milk, for if it is allowed to fall at this time, no amount of care and feed will bring it back to the original flow or anywhere near it.

For soiling crops the farmer has abundant material wherefrom to select. Tests at the Experimental Farm, as well as elsewhere, would seem to indicate vetches, peas, oats, clover and corn as the most suitable crops. Where green feed is required earlier than the time indicated above, fall rye and fall wheat are much used. Fall rye is ready for cutting at the beginning of June; fall wheat a little later.

Dairy farmers are, therefore, recommended to prepare and feed somewhat as follows for each 10 cows in their herds:—

1. Clover, 1 acre.—To have been sown with the mixture of peas and oats the previous year as described below.

Feed off June 20 to July 15.

2. Peas and oats, ½ acre.—Sow 1 bushel peas, 1½ bushel oats, and 5 lbs. red clover seed on one-half acre of land about the first week in May, or earlier if possible.

Feed off July 15 to 31.

3. Peas and oats, ½ acre.—Sow same mixture on another half-acre about third week in May.

Feed off August 1 to 15.

4. Corn, ½ acre.—Sow 10 lbs. Longfellow corn (or other small variety) in hills 3 feet apart each way. Sow third week in May or as early as possible. Sow on well-drained land, clover sod, manured at rate of 20 loads (tons) per acre.

Feed off August 15 to 30.

5. Corn, ½ acre.—Sow 12 lbs. Leaming (or other medium variety) same way as above.

Feed off in September.

For arrangements on a farm to suit soiling, see farm plan page 10.

SUMMER SILOS.

Cutting green feed every day takes considerable time, and frequently interferes with the regular farm work. It increases the labour, and consequently the cost, of feeding, and where labour is scarce and expensive it may not be the most profitable method of working. For such localities, the summer silo is the best method of handling green feeds.

The feed is stored in the fall, and is available for use in a convenient form at any time.

The amount of silage to be fed from the summer silo will of course depend upon the quality and quantity of the pasture, and the nature of the other varieties of feeds supplied to the animals. Here at the Central Experimental Farm, between 20 and 30 lbs. of ensilage per day are fed to each animal during the summer.

Silos for summer feed are built with less diameter but more height than those for winter feed, unless the herd of cattle is large. By this means less surface is exposed from day to day and less waste occurs. The heat of summer causes the exposed surface of ensilage to go bad more quickly than it does in winter.

AUTUMN AND WINTER FEEDING OF DAIRY COWS.

Cows are fed in the stable during one half of the year or more, and feeding during this period may through ignorance or on account of using unsuitable forage, voluntarily or involuntarily, be made very expensive. The profits from the herd will of course depend to a large extent on the economy of the methods of winter feeding followed. Economical feeding does not mean scant supplies, but the using of the kinds of feeds and feed combinations that will be likely to produce the best results at the lowest cost.

As the milk produced depends upon the quantity and quality of the food consumed, every effort should be made to supply the cow with all she will eat of a ration combining palatability, easy digestibility, and suitability in composition for the milk flow.

Observation and experimental work here during the past twelve or thirteen years lead the writer to consider succulence, variety, and regularity in hours of feeding as the most important factors making for palatability and high digestibility of a ration.

SUCCULENCE INCREASES PALATABILITY.

By succulence is meant juiciness or a high percentage of water in the feed. Giving an abundant supply of water for use along with a dry feed will not have the same effect as causing the cow to take the water as a part of her food. To illustrate:—100 lbs. of fresh pasture grass may include as much as 85 lbs. or more of water and only 15 lbs. or less of dry matter. This 100 lbs. of pasture grass fed green is, however, as proven by experiment, worth considerably more than the same 15 lbs. dry matter fed in the shape of 15 lbs. dry grass and the cow allowed to drink all she will of water along with the dry grass. Further, the cow will take considerably more of almost any kind of dry matter, and digest it more readily and more completely when fed as a succulent than when fed as a dry food.

Succulence in the winter ration may be secured in several ways. The most common, and the most advantageous from the standpoints of low cost of ration and convenience of handling, is the use of ensilage. Roots of various kinds are however largely used and are very valuable for the purpose. Where both the above are lacking, succulence may be secured by cutting the straw or hay and sprinkling freely with water a few hours or even a couple of days before feeding. Adding about 20 per cent of feed molasses to the water used for sprinkling improves the palatability and effectiveness of such a ration very greatly. Where ensilage is available, it is well to mix from 8 to 12 lbs. chaff with each 100 lbs. ensilage. This should be done some little time before feeding to insure the chaff being moistened.

VARIETY INCREASES PALATABILITY.

Variety in the ration fed the dairy cow adds greatly to its effectiveness by rendering it more palatable. Variety in this connection, however, must not be taken to mean feeding one kind of feed to-day, a different feed or combination of feeds to-morrow and still another ration the next day. Variety in feeding the dairy cow must be secured by combining in the ration, which should be the same or practically the same from day to day, as many different kinds of

roughage and meals or concentrates as it is found convenient or possible to include. Feeding a meal mixture made up of oats, barley, bran, oil-cake meal and corn is likely to give better results than a meal mixture of similar feeding value from a chemical standpoint including, say, only bran and barley and much better results than feeding bran alone. The mixture of meals improves the flavour thus rendering the meal more palatable and hence more digestible. Palatability in a ration adds greatly to digestibility. Improved digestibility means increased effectiveness. The value of variety in the feed is thus apparent.

These remarks must not be taken to mean, however, that a mixture of roughages or a meal mixture once compounded, no other may be fed. It is possible to have two or three quite different mixtures on the go at the same time, provided always that the same feed be fed at the same hour each day. That is, one might feed ensilage, straw and meal in the morning, and roots, straw, hay and bran in the evening or *vice versa*. It will not do, however, to feed ensilage in the morning one day and in the evening of the next. It or any other feed should always be fed at the same hour.

SOME IMPORTANT MINOR AIDS TO PALATABILITY.

The stage at which the various forage crops are harvested has much to do with their flavour and aroma. Early-cut hay is not only superior in composition to the late-cut article, but is much more pleasant in aroma and more acceptable in flavour. The same may be said of most forage crops, the early-cut, well-cured forage plant of practically every description is much superior to the late-cut badly-cured plant of the same species.

Freshly-ground grain is always more palatable than long-ground material and will give better results.

Feed the best feeds, that is, the most palatable feeds, in the morning. Give less acceptable feeds at night or outside in racks or in some such way as will leave the eating of the same a matter of amusement or a pastime, as it were, rather than a duty or a necessity. The cow eats such things best when she really does not need to eat them and, what is more, shows results for the extra feed consumed even though it be inferior in quality.

HOW OFTEN TO FEED.

Some feeders claim it to be necessary to feed several times each day. A common practice is to feed morning, noon, and night. A

satisfactory method as tried here has been to feed as follows: Succulent roughage mixture and meal mixture first thing in the morning, hay after that is cleaned up. This is repeated for the ensilage and meal mixture about 3 p.m. The hay is fed after the cows are all milked about 5.30 p.m.

Experiments extending over some years to determine the relative merits of dividing the ration into two or into three or more portions seemed to indicate that when the same amount of the same kinds of feed was fed in two portions it gave just as good results as when fed in three or more portions.

REGULARITY IN FEEDING.

A certain hour should be chosen as the time to feed each portion and that hour should be adhered to most strictly. Any temporary variation is sure to result in a falling off in milk. Anything likely to irritate the cow or render her uneasy is almost certain to injuriously affect the milk flow.

WATER.

The requirements of the milch cow in the way of water are very considerable. The more milk produced and the more feed consumed, the greater is likely to be the amount of water required. This amount may vary from, say, 75 pounds up to even 300 pounds water in a single 24-hour period. The problems of how to water, when to water and how much water to give, can best be solved by allowing the cow free access to water at all times. The water had better be warmed in winter, but, if it is not convenient to store it in a warm place, it will not pay to warm it artificially.

The individual drinking fountain is probably the best method, but the trough filled periodically and washed out frequently has many advocates. The using of the manger for watering purposes after feeding is practised in some stables, but our experience would lead us to condemn the system as troublesome and less satisfactory from the standpoint of comfort to the animals than the individual bucket. But of one thing care should be taken, no matter what the system adopted, that is, to keep the cups or troughs or water supply clean and sweet.

SALT.

Salt is necessary to the comfort and health of the dairy cow. The quantity to feed will vary from an ounce to three or four

ounces a day. It might, as in the case of the calf, be given in the form of rock salt in the manger, but had better be fed daily in the food. It adds to the palatability of a food, hence is valuable as an appetizer, as a food and as a stomachic.

EXERCISE.

Exercise when taken by the dairy cow is not immediately conducive to milk production. On the contrary, anything that might be called exertion is practically certain to lower the milk flow temporarily. It would, however, be unwise to say that the dairy cow should have no exercise while producing milk. It is probable that the allowing of a moderate amount of exercise will have a beneficial effect upon the health of the animal and almost certain that such exercise will advantageously affect the offspring. Turning the cow out in cold winter weather, however, to shiver, if only for half an hour a day, in the winter winds, is likely to prove anything but healthful to the cow, economical to the farmer or advantageous to the breeder.

THE PHILOSOPHY OF FEEDING.

The maintenance of life in any animal means food consumption. The performance of work means proportionately so much more food required by the animal body, while the production of milk in large or considerable quantities means much more food consumed even relatively since not only must the elements entering into the composition of the milk be secured from some external source, food, but there is a further and very considerable demand for food to supply the energy required to elaborate milk from the material consumed. In brief, the good dairy cow is necessarily a large consumer of food. Food consumption is her business.

The food consumed should, and usually does, contain the elements found necessary to repair the body waste and elaborate that much-desired product, milk. The animal body consists of (1) water, from 40 to 65 per cent; (2) ash or mineral matter, from 2 to 4 per cent; (3) fat, from 5 to 30 per cent; and (4) nitrogenous material or protein, from 11 to 20 per cent. All these materials should be supplied living animals daily in order to keep them in good health.

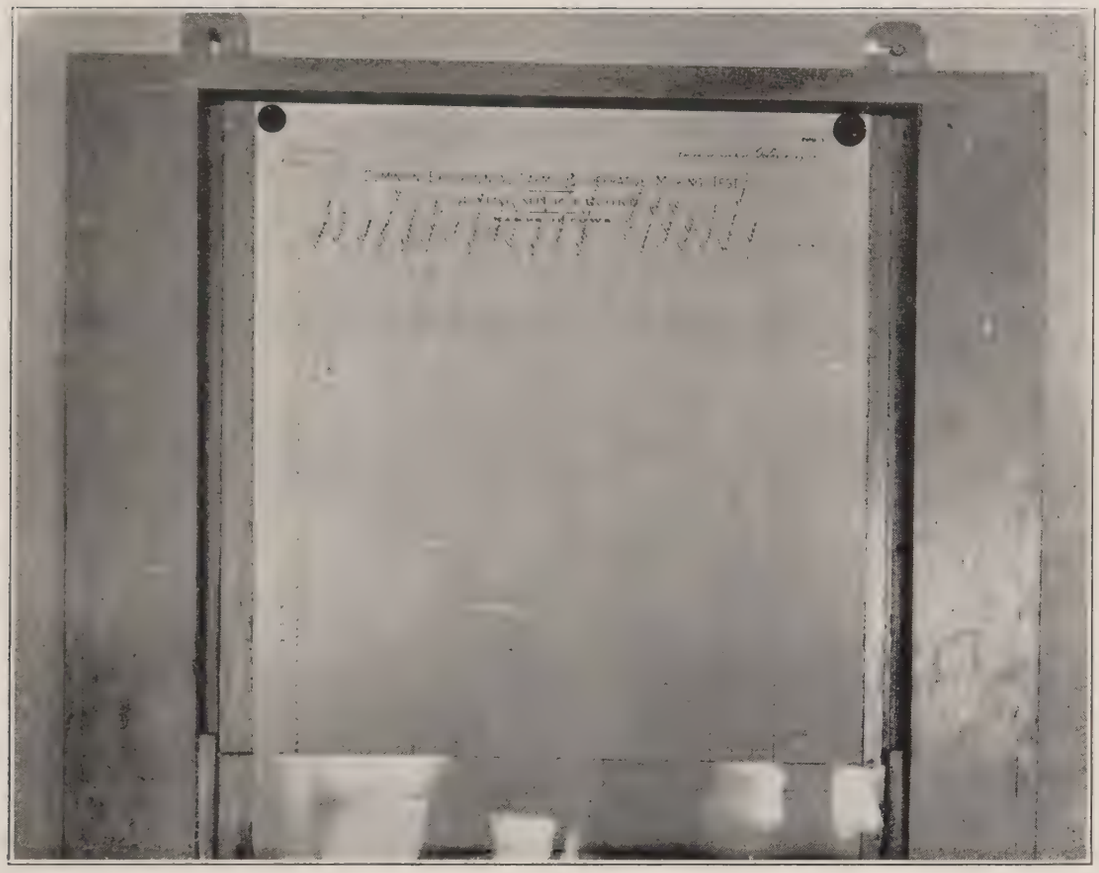
WHAT WE FEED.

As might be expected, the foods commonly fed cattle and other farm animals contain in varying proportions those very elements found to be necessary to the life and profitable exploitation of the dairy cow. Plants or their parts, however, contain in considerable quantities a substance called 'carbohydrates' in addition to the protein, water, fat and mineral matters or ash.

Water.—All feed stuffs contain water. The proportion varies from 8 to 10 per cent in grain, hay, etc., to 90 or even 95 per cent in certain varieties of roots or lush-growing peas and clover. The water in feeds is of no greater food value than common drinking water; but its presence may materially affect the palatability of a food.

Carbohydrates.—Carbohydrates may be said to be of two kinds: Nitrogen-free extract, as starch, sugar, gums, etc., and cellulose or fibre, the principal part of vegetable cell walls. These substances are converted by the animal into fat and so stored in the body or are used at once to produce heat or energy. Carbohydrates, constituting as they do the largest part of most feeding stuffs, are made

PLATE XIX.



The Record Sheet furnished free on application. See page 33.

"The Meal Cart." Note:—3 wheels; 2 compartments; spring balance; feed scoop.

the basis for ration calculations. Fat, it has been determined, is worth about 2¼ times as much as carbohydrates pound for pound.

Protein.—Protein (or nitrogenous material) is that constituent of the plant containing nitrogen. It is sometimes called the 'flesh former.' It enters into the composition of most parts of the animal body and is a most important constituent of milk. No other substance can take its place. It is believed, however, that protein may take the place of, or can be converted into, fat. It is thus evident that protein is an indispensable part of every ration.

Fat.—Fat is the part of a feeding stuff that may be dissolved from it by ether. Real fats, moreover, include wax and some other constituents of plants. Fat in the food may be stored in the body as fat, used to maintain the heat of the body or converted into the fat of milk. As already stated, one pound of fat is worth about 2¼ pounds of carbohydrates for heat production.

Ash.—Ash is what is left after the combustible part of a feeding stuff is burned away. It is used in the formation of bone and the elaboration of the digestive juices.

Water is the most common and the most important substance in the body. It serves as a solvent for most solids in the body and enters largely into the composition of every part of it as well as plays a most important part in all functions.

Mineral matter enters more or less into the composition of the muscles and other soft tissues, but is used most largely in building up bone.

Fat is found in greater or less quantities in most tissues while protein enters into the composition of practically every part of the animal body or product. Milk, with the production of which we are especially concerned, has protein for about one-third of its dry matter content, and fat for another third thereof, while sugar, etc., make up the rest.

PROPORTIONS IN WHICH DIFFERENT FOOD CONSTITUENTS SHOULD BE FED TO DAIRY COWS.

A great deal of work has been done by investigators to determine just how much of each of these food constituents is needed by animals under given conditions. It is a general principle that an animal should have as much water as its body calls for, and sufficient ash seems to be fed in ordinary rations to meet all demands. It

is evident, therefore, that if it be possible to determine just how much of each of the three remaining classes of nutrients—protein, carbohydrates, and fat—is needed, and if it be known how much of each the various feeding stuffs contain, it will not be a difficult matter to compute the ration.

Meaning of 'Ration.'

By 'Ration' is meant (1) the total amount of food of all kinds fed to an animal in each or any 24-hour or day-long period, and (2) in a general way, the mixture of feeds being fed any given herd or individual.

Digestible Constituents.

By the use of reagents, the chemist can determine the exact percentage of any given substance in a food. The digestive organs of the cow, while able to utilize or digest certain proportions of the different substances, are seldom or never able to dissolve the whole of any food or of any particular constituent, as protein, carbohydrates or fat, contained in that food.

By careful experimental work it has been possible to determine just what percentage of any given substance in a food is digestible by cattle.

The quantity so digestible is called 'digestible protein,' 'digestible fat' or 'digestible carbohydrates,' as the case may be.

Nutritive Ratio.

The proportion existing between the digestible protein and the sum of the digestible carbohydrates and the fat multiplied by 2¼ in any particular feed or in any mixture of feeds, is known as the nutritive ratio of the feed or of the mixture. Thus in the case of wheat bran there is about 11·9 pounds digestible protein to 47·6 pounds of digestible carbohydrates plus fat x 2¼. If the number 47·6 be divided by 11·9 it will be found to go 4 times. It is then said that the nutritive ration of wheat bran is 1 to 4. This is usually written: N.R. 1: 4.

A ration where the amount of carbohydrates and fat is large in proportion to the amount of protein is said to have a *'wide' nutritive ratio.* A ration where the proportion was 1 of protein

to 8 of carbohydrates and fat, written usually N.R. 1: 8, would be called wide for a dairy cow in milk. 'N.R. 1: 8' is read 'Nutritive Ratio 1 to 8.'

A ration with a large amount of protein in proportion to the carbohydrates and fat, say 1 protein to 3·2 carbohydrates and fat, that is N.R. 1: 3·2, would be called a *narrow ration* for a cow in milk.

A ration in which the proportion between the principal constituents, protein on the one side and carbohydrates and fat on the other is such that for the amount of feed the best possible results are obtained in the way of milk, in the case of the dairy cow, is said to be a '*balanced ration.*' As given in the 'Wolff-Lehmann Feeding Standard' below, a balanced ration for a cow giving about 27·5 lbs. milk should show 1 protein to 4·5 carbohydrates and fat, that is N.R. 1: 4·5.

FEEDING STANDARDS.

Investigations made into the amounts of protein, carbohydrates and fats required by animals, and the amount of each available in the various feeding stuffs, have resulted in the evolving of what are commonly called 'Feeding Standards,' indicating what experience and investigation have found to be the approximately proper amounts of each of these essential food constituents to include in a ration for the best results.

Some of the better known of these 'Standards,' so far as dairy cattle are concerned, are given below:—

Wolff-Lehmann Feeding Standard.

(German Investigations.)

Milch cows when yielding.	Per day, 1,000 lbs. live weight.		Nutritive Ratio.
	Digestible protein.	Digestible Carbohydrates plus fat x 2 25.	
11 lbs milk daily	1·6	10·7	1 : 6·7
16·6 " "	2·0	11·9	1 : 6·0
22 " "	2·5	14·1	1 : 5·7
27·5 " "	3·3	14·8	1 : 4·5

Wisconsin Standard.

POUNDS OF DRY MATTER, DIGESTIBLE MATTER AND DIGESTIBLE PROTEIN TO BE FURNISHED IN RATIONS FOR DAIRY COWS.

Live Weight.	Dry cows.	Production of Butter fat per day in Pounds.						
		Less than 0·5 lb.	0·5–0·75	0·75–1·0	1·0–1·25	1·25–1·5	1·5–1·75	1·75–2.0
		POUNDS DRY MATTER TO BE FURNISHED IN RATIONS.						
800	10·0	13·7	16·2	18·6	21·1	23·5	26·0	28·4
900	11·3	15·0	17·5	19·9	22·4	24·8	27·3	29·7
1,000	12·5	16·2	18·7	21·1	23·6	26·0	28·5	30·9
1,100	13·8	17·5	20·0	22·4	24·9	27·3	29·8	32·2
1,200	15·0	18·7	21·2	23·6	26·1	28·5	31·0	33·4
1,300	16·3	20·0	22·5	24·9	27·4	29·8	32·3	34·7
1,400	17·5	21·2	23·7	26·1	28·6	31·0	33·5	35·9
1,500	18·8	22·5	25·0	27·4	29·9	32·8	34·7	37·2
		POUNDS DIGESTIBLE MATTER TO BE FURNISHED IN RATIONS.						
800	·56	1·04	1·35	1·66	1·97	2·29	2·60	2·91
900	·63	1·11	1·42	1·73	2·04	2·36	2·67	2·93
1,000	·70	1·18	1·49	1·80	2·11	2·43	2·74	3·05
1,100	·77	1·25	1·56	1·87	2·18	2·50	2·81	3·12
1,200	·84	1·32	1·63	1·94	2·25	2·57	2·88	3·19
1,300	·91	1·39	1·70	2·01	2·32	2·64	2·95	3·26
1,400	·98	1·46	1·77	2·08	2·39	2·71	3·02	3·33
1,500	1·05	1·53	1·84	2·15	2·46	2·78	3·09	3·40
		POUNDS DIGESTIBLE PROTEIN TO BE FURNISHED IN RATIONS.						
800	6·3	9.0	10·7	12·5	14·2	16·0	17·7	19·5
900	7·1	9·8	11·5	13·3	15·0	16·8	18·5	20·3
1,000	7·9	10·6	12·3	14·1	15·8	17·6	19·3	21·1
1,100	8·7	11·4	13·1	14·9	16·6	18·4	20 1	21·9
1,200	9·5	12·2	13·9	15·7	17·4	19·2	20·9	22·7
1,300	10·3	13·0	14·7	16·5	18·2	20·0	21·7	23·5
1,400	11·1	13·8	15·5	17·3	19·0	20·8	22·5	24·3
1,500	11·9	14·6	16·3	18·1	19·8	21·6	23·3	25·1

The Haecker Feeding Standard.

(Minnesota, U.S.A.)

—	Daily Allowance of Digestible Nutrients.		Nutritive ratio.
	Crude Protein.	Carbohydrates plus fat x 2·25.	
For support of the 1,000 lb. cow.....	lbs. 0·700	lbs. 7·00	
To the allowance for support add:—			
For each lb. of 3·0 per cent milk....	0 040	0·22	1 : 5·5
" lb. of 3·5 "	0·042	0·24	1 : 5·7
" lb. of 4·0 "	0·047	0·27	1 : 5·74
" lb. of 4·5 "	0·049	0·30	1 : 6·1
" lb. of 5·0 "	0·051	0·31	1 : 6·1
" lb. of 5·5 "	0·054	0·33	1 : 6·1
" lb. of 6·0 "	0·057	0·36	1 : 6·3
" lb. of 6·5 "	0·061	0·38	1 : 6·3
" lb. of 7·0 "	0·063	0·41	1 : 6·5

In using this standard prepared by Professor Hæcker at the Minnesota Station, it is necessary to change the amount of food indicated 'For support of the 1,000 lb. cow' in proportion to the weight of the cow being considered, that is while a 1,000 lb. cow requires 0·700 lbs. crude protein and 7·225 lbs. carbohydrates plus fat x 2·25, a 1,200 lb. cow would require 1,200 or six-fifths of these amounts, or 0·840 lbs. crude protein and 8·670 lbs. carbohydrates plus fat x 2·25.

Kellner's Standard.

1,000 lb. Cow.

—	Dry matter.	Digestible Protein.
	lbs.	lbs.
Milch cow yielding 20 lbs. milk daily.....	25·29	1·6 to 1·9
" " 30 "	27·33	2·2 to 2·5
" " 40 "	27·34	2·8 to 3·2

SCANDINAVIAN STANDARD.

—	Digestible Protein.
	lbs.
Milch cow yielding 0 to 13 lbs. milk....	1·10
" " 22 lbs. milk	1·65
" " 33 "	2·20
" " 44 "	2·75

A glance at the above Feeding Standards indicates the necessity of the feeder having at hand tables showing the composition of the feeding stuffs he is using. In the tables on page 116 and following, compiled from various sources, (Henry's Feeds and Feeding in most cases) will be found the quantity of dry matter, digestible protein and digestible carbohydrates, plus fat, (the latter multiplied by the co-efficient 2¼, that is 2·25) in 100 pounds of an average sample of each of the feeding stuffs mentioned. Not infrequently, feeds being fed differ materially in composition from the average as given in the tables just mentioned. This might be due to various causes, as weathering in the case of hay, or drought at filling time in the case of grain.

Among the feeds in the tables as mentioned above, will be found a number that, so far as composition is concerned, come very nearly fulfilling the requirements of the Feeding Standards. We know that it is impossible, however, without serious injury to the health of the cows and to the yield of milk, to feed them exclusively on any one feed, as roots or grain, or even on good corn ensilage alone, and that to ensure good results, these feeds must be mixed in certain more or less definite proportions, such as theory and practical agriculture have together worked out.

A study of the different kinds of foods available is, therefore, necessary so that the proper quantities of the substances in the foods, viz,—proteins, carbohydrates and fats, may be given to the animals and the best results thus attained.

Moreover, it is necessary, both for the sake of economy and for the health of the animal, to weigh or measure the amount of feed given to each. In order that a cow may digest her food to the best advantage, she must receive a considerable volume of bulky food,

part of which will necessarily be of low nutritive value. As a matter of fact, her total ration should include from 25 to 35 pounds or even more dry matter. It is evident, therefore, that a great deal of roughage has to be fed so that this quantity of dry matter may be supplied to the cow. Experience has shown that for a 1,000 pound animal, a good roughage ration is 35 lbs. corn ensilage, 20 lbs. mangels, 5 lbs. clover hay and a little chaff.

The amount and character of the meal mixture or concentrate part of the ration will be affected by the amount of milk being produced.

If a cow responds freely to an increase of meal she should be fed all the more liberally up to that point where a further increase in the quantity of meal does not seem to produce a relative increase in milk flow.

One pound of meal for four pounds of milk is liberal feeding; one pound for three pounds of milk would be hardly economical unless dairy products were bringing relatively a very high price.

The quality or composition of the meal ration is an important factor affecting the milk yield. As a rule, heavy milking cows can and will make better use of meal mixtures containing heavy meals such as corn, gluten meal, oil cake and cotton seed meal, than will small producers.

Further, it is exceedingly important to remember that palatability in the meal as well as in the roughage is an influence that is not infrequently underestimated. Variety in meals fed is advisable, but variety should mean a blending of meals not a substitution of one for another at frequent intervals. To illustrate, it is much better to feed a mixture of bran, oats, barley, oil meal, gluten, cotton-seed meal, etc., than to feed any single one of them for a time, to be subsequently replaced by some other.

INDIVIDUALITY OF COWS.

Another point to be kept in mind is that considerable difference may be observed in individual cows as to their feeding capacity and the returns they make for the food supplied them. These differences may in turn be ascribed to differences in the maintenance requirements of each. The maintenance requirement is the 'amount of food required to prevent the body consuming its own tissues.' In this maintenance requirement, considerable variation may be observed in individuals of the same breeds on similar feeds and under like

conditions. It seems probable that much of this variation is due to differences in the temperament of the animals. Obviously, the maintenance requirement of a quiet, placid animal will be considerably less than that of a restless one.

The individuality of cows, therefore, and especially in the matter of their responsiveness to feed, ought to be a matter of continual study to the dairyman.

HOW TO USE THE TABLES OF COMPOSITION AND THE FEEDING STANDARDS.

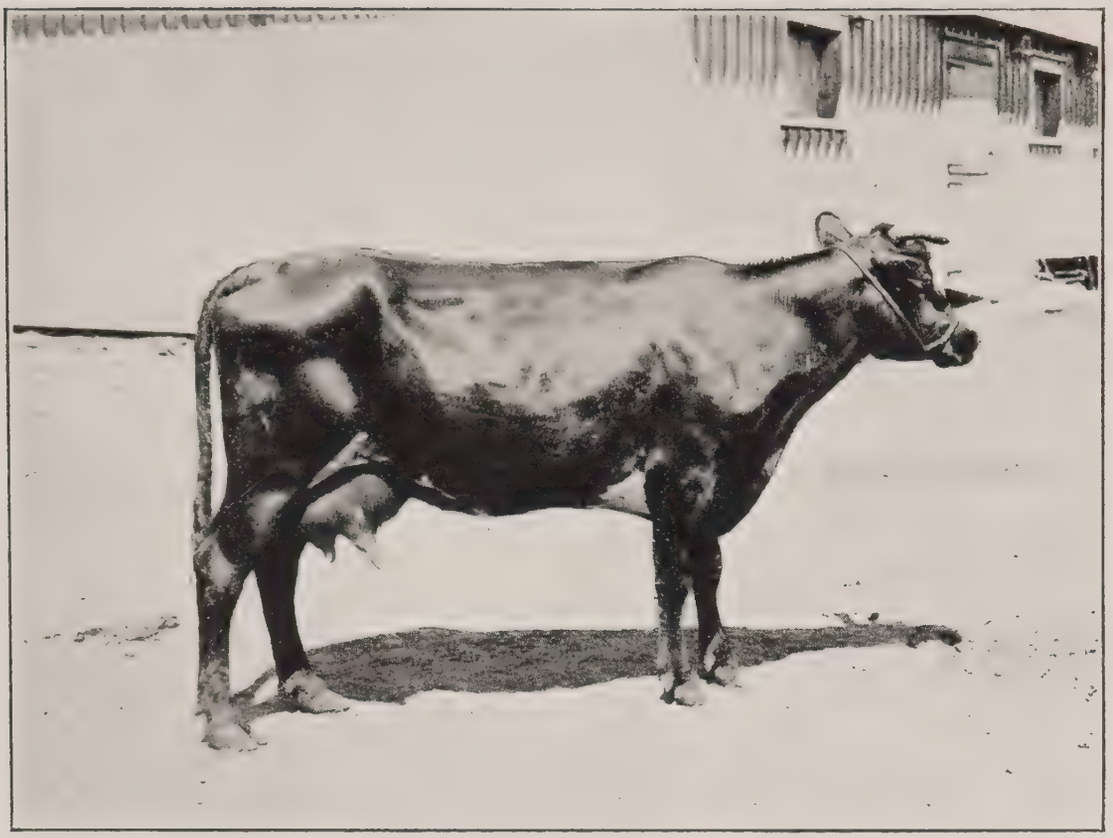
To show how to use the tables of feed composition as given on page 117 *et seq.*, in such a way as to learn the probable value of a given ration, or to compound an entirely new ration, the feeds available being known, the following problems and their solutions are given.

Problem I.—'To a thousand-pound Ayrshire cow, yielding 30 lbs. of milk a day, there is being fed 35 lbs. corn ensilage, 10 lbs. cut oat straw, 5 lbs. clover hay, 3 lbs. bran and 2 lbs. crushed oats. Could this ration be improved upon, and, if so, how?'

Discussion.—Reference to the Feeding tables shows the following to be the feeding value of the ration described:—

Feed.	Digestible Protein.	Digestible Carbohydrates plus digestible fat x 2¼.	Nutritive Ratio.
	lbs.	lbs.	
35 lbs. corn ensilage	·490	5·530	
10 lbs. oats straw	·130	4·130	
5 lbs. clover hay	·355	2·095	
3 lbs. wheat bran	·357	1·428	
2 lbs. crushed oats	·176	1·178	
	1·508	14·361	1 : 9·55
Requirements of :—			
1. Wolff-Lehmann Standard about..	3 5	15·2	1 : 4·50
2. Wisconsin " " ..	2·11	15·8	
3. Haecker " " ..	2·00	14·5	
4. Kellner's " " ..	2·40		
5. Scandinavian " " ..	2·25		

This ration, according to any or all of the Feeding Standards given, is evidently much too wide, and to correct this condition it



Milking Shorthorn Illuminata III. Produced 8,555 lbs. 3·77 per cent milk in 327 days as a mature cow.

Holstein Cow—De Kol Pauline Sadie Val, Champion Holstein cow at Toronto, 1910.
27889—p. 80.

Canadian Cow—Fortune Precoce—Produced 6,639 lbs. milk 4·47 per cent fat in 269 days, as 4 yr. old.

Ayrshire Cow—Hillhead—1437—13 yrs. old. Many times a champion.

will be necessary to either add or substitute some feed rather rich in protein.

The diminution of the straw to 5 lbs. instead of 10, the increasing of the clover hay from 5 up to 10 lbs., the increasing of the bran to 4 lbs. and the addition of 2 lbs. of oil cake meal, would mean a much better ration for such a cow, and a ration that would probably result in a considerable increase in the flow of milk. Below is given the new ration, worked out in the same way as the old:—

Feed.	Digestible Protein.	Digestible Carbohydrates plus digestible fat x 2¼.	Nutritive Ratio.
	lbs.	lbs.	
35 lbs. corn ensilage	·490	5·530	
5 lbs. oat straw	·065	2·065	
10 lbs. clover hay	·710	4·190	
4 lbs. wheat bran	·476	1·904	
2 lbs. crushed oats	·176	1·178	
2 lbs. oil cake	·630	·822	
	2·547	15·689	1 : 6·2

This modified ration is apparently still too wide according to the Wolff-Lehmann; it is however quite as narrow as necessary according to the other Standards given, which are probably the more nearly right. Further, as this ration is made up almost entirely from exceedingly palatable feeds, corn ensilage, clover hay, wheat bran, crushed oats and oil cake meal, is is probable that it is as good a ration as could be fed such a cow and almost certainly more profitable than would be a ration complying more nearly with the requirements of the Wolff-Lehmann feeding standard, since to narrow the nutritive ratio down to 1: 4·5 would mean the addition of about 3 lbs. more oil cake or else the still further substitution of clover for straw or of clover in the place of part of the ensilage. Our experience here would seem to show that while the Wolff-Lehmann Standards are probably right where no attention is paid to the effect of feeds on palatability, they are apparently unnecessarily narrow when easily digestible, highly palatable feeds make up the ration. In this, our experience seems to bear out the findings of the Wisconsin and other investigators both American and European, whose

standards, it will have been observed, are of much wider nutritive ratio than the Wolff-Lehmann under similar conditions.

Further, we have seldom found it profitable to feed more than one pound of meal mixture or concentrate to about four pounds of milk produced. Of course, if the cow was giving 30 lbs. of milk on the ration mentioned in the inquiry, she is practically certain to give considerably more, probably 35 to 40 lbs. on the new ration as suggested.

Problem II.—A farmer has at his disposition clover hay, mixed hay, wheat chaff, mangels and oat straw. He has also a small amount of oats and he can conveniently purchase gluten meal, bran and cotton seed meal. He is particularly anxious to produce a large quantity of milk. His cows are for the most part Holstein grades and not long calved. What would be a good ration compounded from all or any of the feeds mentioned?

Solution.—Nothing is said of the quantities of different feeds available hence it will have to be taken for granted that they are any and all, except oats, available in any quantities desired.

The Holstein grade being usually a large cow of 1,200 to 1,500 lbs., a ration must be compiled accordingly. As already indicated, variety is an excellent quality in a ration, so, although a suitable ration might be prepared from which some of the feeds could be left out, it will probably be found advisable to include them all in one proportion or another.

The ration given in the following table suggests itself:

Feed.	Amount.	Dry Matter.	Digestible Protein.	Digestible Carbohydrates plus fat x 2¼	Nutritive Ratio.
	lbs.	lbs.	lbs.	lbs.	
Clover hay.....	8	6·776	0·568	3·352	
Mixed hay.....	5	4·355	0·295	2·180	
Wheat chaff.....	5	4·285	0·060	1·335	
Oat straw	8	7·272	0·104	3·304	
Mangels.....	50	4·550	0·550	2·950	
Oats.....	2	1·792	0·176	1·178	
Gluten meal	2	1·810	0·594	1·124	
Cotton seed..	2	1·860	0·752	0·860	
Bran.....	5	4·405	0·595	2·380	
		37·105	3·694	18·663	
Wisconsin Standard, about :....	.....	35·9	3·33		

Since the Wolff-Lehmann Standards do not go above 30 lbs. of milk per diem it will be necessary to compare this with the Wisconsin Standard as given on page 76. This Standard calls for 3·33 lbs. digestible protein, 35·9 lbs. dry matter and 24·3 lbs. digestible dry matter (digestible protein plus digestible fat x 2¼) for a 1,400 pound cow giving from 1·75 to 2·00 lbs. butter fat per diem, which is the maximum such cows might be expected to give when fresh.

The ration as suggested shows 37·105 lbs. dry matter, 3·694 lbs. digestible protein and 18·663 lbs. digestible carbohydrates and fat, approximately the same as in the Wisconsin Standard.

The ration as suggested might be fed as follows:

Morning.—25 lbs. mangels, 5 lbs. mixed hay; 5 lbs, oat straw; and half the meal mixture, since the best way to feed the 2 lbs. each gluten meal, oats and cotton seed meal and the 5 lbs. bran would be as a meal mixture made up in those proportions. *Afternoon or evening,* 25 lbs. mangels, 8 lbs. clover hay, 5 lbs. wheat chaff and half meal mixture.

It is probable that the wheat chaff would not be all eaten but what was left could be thrown back for litter under the cow.

If more concentrates were necessary, that is, if it were found advisable to give some heavy producing individuals more meal, an extra amount of the meal mixture described would probably be as good as anything that could be fed. Making the proportion of gluten or cotton seed meal 3 instead of 2 would probably be a slight improvement, although any increase of the heavier meals in a mixture must be made gradually and the effects carefully watched.

FEEDING METHODS PRACTISED AND DAIRY RATIONS FED BY CERTAIN FARMERS.

To give the beginner some idea of what feeding methods are actually followed in various parts of Canada letters were sent to a number of the best dairymen in each province, asking them to state briefly their methods of feeding cows both summer and winter. Some of the replies are summarized below.

Further on are submitted what the writer considers would be the methods of feeding and the rations most likely to prove satisfactory and profitable in the various provinces mentioned.

In the Eastern provinces and British Columbia the ration suggested is for a 1,000 lb. cow.

In the Prairie provinces the ration suggested is for a 1,200 lb. cow.

PRINCE EDWARD ISLAND.

J. H. S., Bay View, P.E.I.—Feeds grain all the year round. When grass begins to fail, supplies green feed, oats and peas, vetches, corn and roots. Allows cows to pasture on the aftermath of clover and timothy crop. For winter ration, feeds: 50 lbs. pulped turnips, clover and timothy hay all they will eat, and a small quantity of oat and barley dust.

F. G., Margate, P.E.I.—Puts cows on pasture about June 15. Soils with oats and vetches, later corn. No meal in summer. In winter feeds silage, roots, oat and vetch hay, with two gallons crushed oats.

W. C. & S., North Wiltshire, P.E.I.—Feed no grain during first two months of pasture, but after that, supply for one month 35 lbs. green feed (oats, peas and vetches) 4 lbs. crushed oats and 2 lbs. bran per day. Next two months feed 40 lbs. corn fodder, 6 lbs. crushed oats, 2 lbs. bran and 1 lb. oil cake. The winter ration consists of 30 lbs. roots, 15 lbs. hay, 8 lbs. straw, 6 lbs. crushed oats, 2 lbs. bran and 1 lb. oil cake.

NOVA SCOTIA.

S. A. L., Amherst Point, N.S.—Feeds 3 to 6 lbs. bran or middlings to each cow at pasture. When pasture begins to fail, soiling crops (peas and oats, vetches, corn and turnips) supplied. When cattle are housed feed consists of marsh hay all they will eat, 10 to 60 lbs. swede turnips, 4 to 10 lbs. per day of meal—crushed barley, oats, peas, wheat bran, oil cake or gluten meal or mixtures of these.

F. M. T., Antigonish, N.S.—Feeds cows nothing but pasture until toward end of August when soiling is resorted to, the crops being peas and oats, vetches and oats and, later, turnips. The winter feed is made up as follows: 20 lbs. clover hay, oat straw all they will eat; 40 lbs. turnips; 8 to 12 lbs. meal (wheat bran and cotton-seed meal in proportion of 100 to 20).

C. A. A., Truro, N.S.—As a rule feeds no grain to cows at pasture, but in dry season supplies one quart oil cake meal and two quarts of wheat bran once a day. In winter, hay all they will eat, 1

bushel roots, one quart oil cake and two quarts oats, barley and pea chop mixed with the roots make up the ration. Much of the hay is grown on undyked marshes.

E. S. A., Truro, N.S.—Feeds in pasture season 3 to 6 lbs. meal to newly-freshened cows. Feeds also large amounts of green feed, viz., rape, mixed peas, oats and vetches, second cut of clover and corn. In winter he supplies for roughage ½ to 1 bushel roots, 15 to 20 lbs. ensilage, 9 to 15 lbs. hay. The meal ration is fixed, according to the breed and production of the animal, between the following figures: Holsteins, 12 to 15 lbs.; Ayrshires, 7 to 12 lbs.; Jerseys, 6 to 10 lbs.

NEW BRUNSWICK.

J. F. R., Sussex, N.B.—Cows put to pasture end of May. Very little grain is fed. Green feed (oats, peas and corn) is supplied. In winter 4 lbs. wheat middlings, 4 lbs. bran or shorts, 2 lbs. cottonseed meal, one-half bushel turnips and 30 lbs. mixed hay are given.

H. H. S., Upham, N.B.—Cows put to pasture about middle of June. Beginning of August green oats and peas are fed, and, later, turnips along with 3 quarts middlings, bran or meal. Turnips, clover or timothy hay, 3 quarts bran, 3 quarts middlings, and one quart meal make up the winter ration.

E. A. S., Hampton, N.B.—Does not usually feed grain while cows are at pasture. Green feed is supplied in late summer. For winter feed, one bushel pulped turnips, 8 to 10 lbs. hay with one lb. of the following mixture for every 4 lbs. of milk produced: 3 bags bran, 2 bags middlings, 1 bag corn meal, 1 pail cottonseed meal.

G. R. Bloomfield Station, N.B.—Cows put to pasture June 1. No grain, but in August green feed (oats and peas, vetch and buckwheat) is supplied. Hay and straw all they will eat; ½ bushel pulped turnips; 8 lbs. of a mixture of bran and cornmeal with a little oats and barley make up the winter feed.

QUEBEC.

G. F. T., Hudson Heights, Quebec.—Feeds no grain while cows are at pasture, but has ensilage to last until green feed—clover—is ready. In winter the cows get 50 lbs. ensilage, 9 lbs. of meal (shorts and oil cake) and hay all they will eat.

F. E. C., St. Lambert, Quebec.—Cows at pasture get 2 bushels brewers' grains and, in late summer, green feed in addition. In winter, ensilage, hay, brewers' grains, gluten, and cottonseed meal comprise the ration.

J. C. P., West Brome, Quebec.—Feeds a little grain (oats, middlings, bran, corn meal, shorts and schumacker) when pastures begin to fail. From middle of July, green feed, peas, oats and barley and, later, green corn are supplied. The winter ration is made up of 30 lbs. ensilage, roots, clover hay, ground oats and corn meal or bran and meal.

Institut Agricole, Oka, Quebec.—No grain is fed while cows are at pasture, but when grass fails, green oats, peas, vetches, alfalfa and rape are supplied. The winter feed is: 25 lbs. ensilage, 20 lbs. mangels, 12 lbs. alfalfa, 3 lbs. bran, 2 lbs. oats, 2 lbs. barley, 1 lb. oil meal.

N. L., St. Paul l'Ermite, Quebec.—Cows get only pasture until August when corn and other green feed is supplied. In winter, 8 lbs. each of hay and straw, 10 lbs. of mixture of barley, oats and buckwheat with a little bran and dust made into a mash make up the ration.

O. S., North Sutton, Quebec.—Cows are put to pasture about end of May. No grain fed, but in the late part of the summer, soiling crops (vetches, millets and corn) are supplied. 30 lbs. turnips, 4 lbs. shorts, 3 lbs. corn meal and as much corn fodder and mixed hay as they will eat make up the winter feed.

T. T., St. Prosper, Quebec.—Cows get pasture alone until August when they get oats and vetches. In September they are allowed the run of the meadow aftermath. Turnip tops are fed in October. Clover hay and hot mash containing 1 lb. bran, ½ lb. oil cake and 30 lbs. turnips make up the winter feed.

J. J. T., White's Station, Quebec.—If pasture is good, no grain is fed. Ensilage with a sprinkling of ground barley and oats when grass gets scarce. The winter ration is 50 lbs. ensilage, alfalfa or clover hay all they will eat; meal (barley and oats, gluten meal, cottonseed meal and bran).

F. V. B., Beaupré, Quebec.—Feeds 2 lbs. oil cake, clover, oats and peas or corn all summer besides allowing cows to run on pasture. In winter feeds 8 lbs. oat meal, 25 lbs. mangels or swedes, 9 lbs. hay, 3 lbs. oil cake and straw all they will eat.

A Quebec ration (Cap Rouge).—Cows put to grass June 1. After middle of July, green feed such as oats and vetches is given. No grain. Winter ration consists of 25 to 30 lbs. of hay, 5 lbs. of a mixture of 2 parts bran, and one part oil cake. Meal mixed with chaff and cut hay and moistened. After 12 hours, this is fed with ¼ lb. salt.

A Quebec ration (Ste. Anne de la Pocatière).—Cows put to grass first week in June. Nothing but pasture until late summer when vetches are fed. In winter feeds hay, straw, and a mash of bran and crushed oats with roots, turnips, beets and potatoes.

ONTARIO.

J. McK., Norwich, Ontario.—Feeds no grain while cows are at pasture; in fall, feeds green sweet corn, and pastures on second growth of alfalfa. Winter ration: Alfalfa hay, 40 lbs. ensilage, 2 lbs. of oil cake or cottonseed meal, 8 to 12 lbs. of ½ oat chop plus ¼ bran plus ¼ gluten; and a few roots.

S. B., Glendale, Ontario.—Feed in winter one bushel ensilage, 12 quarts brewers' grains, several quarts barley, oats and peas (ground) and some clover or alfalfa.

J. H. M., London, Ontario.—Feeds 8 quarts oat chop and shorts while cows are at pasture. Between August 1 and October, feeds green alfalfa, and, later, corn ensilage. Ensilage with cut straw mixed with shorts, together with hay or alfalfa make up the winter ration.

MANITOBA.

D. S., Gladstone, Manitoba.—While cows are at pasture, feeds bran with barley or oats. In winter, cows get barley and oat straw, hay or corn stalks and 2 gallons of mixture equal parts barley chop, oat chop and bran.

W. H. N., Carman, Manitoba.—Feeds 2 gallons oat chop while cows are at pasture. Continues this grain feed throughout winter and feeds also as roughage unthreshed oat sheaves.

W. M. C., Reaburn, Manitoba.—Allows his cows hay all summer while pasturing on prairie grass. In addition, they get 2 to 4 quarts oat chop. In winter, he gives them prairie hay all they will eat, oat sheaves, a little fodder corn, and barley chop, flaxseed mixed with barley, and wheat chop.

A Manitoba ration (Brandon, Manitoba).—Pasture season extends from middle of May to end of November. Summer feed is almost exclusively pasture. For winter feed the following are used: Corn ensilage, 35 lbs.; roots, 15 lbs.; clover or alfalfa hay 12 lbs.; oat straw, 4 lbs.; chopped oats, 6 lbs.; bran 3 lbs.

S. B., Neepawa, Manitoba.—Puts cows to pasture about middle of May. Feeds 2 gallons oat and barley chop until about 1st August when green corn is substituted. Winter ration consists of corn stalks, hay, barley or oat straw. Chop is a mixture of bran, oats and barley. Amounts given according to production of animals.

SASKATCHEWAN.

A. B. P., Langbank, Sask.—Feeds a mixture of oats and barley while cows are at pasture, and in fall some rape. In winter, gives cows all roughage they will eat, and measures grain according to cow. Roughage consists of corn stover, prairie hay, oat and barley straw, some alfalfa hay, and roots. The meal ration is a mixture of oats and barley.

F. O. H., Pense, Sask.—Feeds 3 quarts of oat chop while cows are at pasture. For winter roughage, hay and oat sheaves are supplied and a meal ration consisting of 6 quarts oat chop and 6 quarts bran.

J. T., Abernethy, Sask.—Feeds one gallon chopped oats while cows are at pasture and, later, some sugar beets. Sugar beets and turnips, oat straw, prairie hay, and oat sheaves are the roughage feeds in winter. A slop of oat chop and bran (about 1 gallon each cow) is supplied.

J. McF., Parkbeg, Sask.—Allows only pasture for his cows in summer. In winter wild hay and green oats are the ration.

A Saskatchewan ration (Indian Head).—Pasture lasts from end of May until middle of November. 2 lbs. of a mixture of one part wheat screenings to 2 parts oats are fed during this season. In winter, the ration is 20 lbs. corn ensilage in which is mixed 10 lbs. cut oat straw, 8 lbs. meal (1 part barley, 2 parts oats, 2 parts bran, and 1 part linseed meal).

A Saskatchewan ration (Rosthern).—Cows are pastured exclusively during summer from May 1 to end of September. In winter, they are fed two sheaves of oats, 6 lbs. of oat chop, 4 lbs. bran, and all the prairie hay they can eat up clean.

Canadian Bull—Goldfinder—1613.

Holstein Bull—Artis Mercedes Posch. "Many times a winner of Championships." 27889—p. 88.

ALBERTA.

T. L., Calgary, Alta.—Cows at pasture get green feed of peas and oats, rape, and, later, Aberdeen turnips. In winter, they get 10 lbs. of oat sheaf, hay and oat straw all they will eat and 10 to 15 lbs. of a mixture of bran with chopped oats, frozen wheat or barley.

W. J. T., Calgary, Alta.—Feeds some grain while cows are at pasture and also, in late season, rape, alfalfa and green oats. Prairie hay, oat hay, fodder corn and 3 lbs. per 10 lbs. milk of a mixture of bran, oats and barley chop make up the winter ration.

C. P. R., Strathmore, Alta.—Cows are pastured in early summer on rye sown preceding fall, and later on permanent pasture. In winter, they get either alfalfa with crushed oats and barley, or prairie hay and crushed oats with barley and bran (2 parts bran; 2 parts crushed oats; 1 part barley) 5 to 5½ lbs. of this grain ration is fed per cow.

C. A. J. S., Red Deer, Alta.—Uses rye for early spring and late fall pasture. Pastures also on prairie grass with fodder corn for soiling. In winter, gives the animals all they will clean up of alfalfa, hay from brome and western rye grass, barley and oats (cut green). In addition to these they get some roots, and some chop (3 of oats to 1 of wheat).

An Alberta ration (Lethbridge).—Cows put to pasture about 1st of May. No grain nor soiling crops are fed. In winter, cows are supplied with 30 lbs. alfalfa hay, 20 lbs. mangels and 4 to 5 lbs. bran.

BRITISH COLUMBIA.

W. F. H., Eburne, B.C.—Feeds nothing but pasture until middle of July after which he supplies about 5 lbs. ground oats. His winter ration is: 40 lbs. corn ensilage, 5 lbs. finely-ground oats, 6 lbs. shorts, 4 lbs. bran, 40 lbs. roots, 2 to 3 lbs. hay, and oat straw.

F. S., Agassiz, B.C.—While cows are at pasture, feeds 2 to 5 lbs. of a mixture of bran and shorts (2:1). In winter feeds 20 to 30 lbs. of mangels or turnips, 4 to 6 lbs. of bran and shorts, mixed hay.

M. B., Eburne, B.C.—Feeds no meal while cows are at pasture, but in late summer, supplies green clover or oats. The winter ration is as follows: Bran and oats in equal quantities up to 8 lbs. per day, pulped mangels, corn silage and brewers' grains all mixed. The allowance of brewers' grains is about 50 lbs., and of the mixture above described, the animals are fed all they will eat.

SOME SUGGESTED METHODS AND RATIONS.

From experience in Ontario and Quebec and from observation and enquiry in other provinces, the writer would offer the following suggestions as to methods and rations.

MARITIME PROVINCES, ONTARIO, QUEBEC AND BRITISH COLUMBIA.

Summer.—Cows on pasture from time grass is 6 to 8 inches high. Pasture supplemented by soiling crops or ensilage as soon as cows show any signs of falling off in milk yield.

While on grass, feed small amount meal mixture, equal parts bran, crushed oats and corn meal, say from 1 to 3 lbs. per cow in full milk. Cows being fed ensilage may require somewhat larger portion.

Winter.—Provide liberal supply of succulent feed, as mangels, sugar mangels, sugar beets, turnips, swedes, corn ensilage, clover ensilage, etc.

Feed moderate amounts, clover hay, mixed hay, English hay, alfalfa, corn forage, corn stover, marsh hay, etc.

Feed with succulent feed some oat chaff, oat straw, barley straw, etc.

Supply meal mixture made up of two or more of the following, one or more out of each group:—

Group (a).—Crushed oats, corn meal, bran, shorts, buckwheat shorts, barley meal, gluten feed, brewers' grains, distillers' grains, etc.

Group (b).—Cottonseed meal, oil cake meal, gluten meal, peas, horse beans.

Suggested Rations for 1,000 Pound Cows.

Ration 1.—Roots 50 lbs., clover hay, 20 lbs., oat straw, 5 lbs. Meal mixture: Bran 500, oats, 200, corn, 300, gluten meal, 300. Fed one pound meal to each four pounds milk produced.

Ration 2.—Roots, 20 lbs., corn ensilage, 35 lbs., clover hay, 10 lbs., oat straw 5 lbs. Meal mixture: Bran, 500, oil cake meal, 300, corn, 200. One pound to each four pounds milk produced.

Ration 3.—Clover hay, 20 lbs., oat straw, 10 lbs. Meal mixture: Bran, 500, oil cake meal, 300, oats, 200. Fed one pound to each three pounds milk produced.

Ration 4.—Corn ensilage, 40 lbs., oat chaff, 5 lbs., alfalfa hay 8 lbs. Meal mixture: Bran, 500, gluten, 200, oil cake meal, 300, barley, 200. Fed one pound to four pounds milk produced.

Ration 5.—Corn ensilage, 40 lbs., alfalfa, 10 lbs., oat straw, 10 lbs. Meal mixture: Bran, 500, oats, 500, barley, 500, cottonseed meal, 500. Fed one pound to four pounds milk produced.

PRAIRIE PROVINCES.

Summer.—Cows on pasture from time grass is 4 to 6 inches high. Pasture supplemented by soiling crops, peas and oats, oats, vetches, etc., as soon as cattle show signs of falling off in milk flow. While on grass, or on grass and soiling crops, feed moderate amount suitable meal mixture as bran, oats, barley, equal parts, at rate of from 1 to 4 or even 5 pounds a day.

Winter.—Some succulent feed if at all possible. Corn ensilage, mangels, turnips, potatoes, etc. Hay from clover, alfalfa, brome, western rye, wild prairie grasses, oat sheaf, mixed oat and pea hay, mixed oat, wheat and barley, cut green, etc., oat chaff, wheat chaff, oat straw, barley straw, slough hay, etc.

Meal mixture made up of two or more of the following one or more out of each group:—

Group (a).—Bran, crushed oats, spelt or emmer, shorts, etc.

Group (b).—Small wheat, frozen wheat, barley, oil cake meal, flax, peas, beans, etc.

Suggested Rations for 1,200 Pound Cow on Prairies.

Ration 6.—Corn silage 30 lbs., Western rye grass, 10 lbs., oat chaff, 10 lbs. Meal mixture: Bran, 300, oats, 300, flax, 200, small wheat, 200. Fed one pound mixture to three pounds milk produced.

Ration 7.—Mangels or turnips 30 lbs., brome hay, 10 lbs., clover hay, 5 lbs., oat chaff, 10 lbs. Meal mixture: Oats, 300, barley, 200, small wheat, ground, 200. Fed one pound meal mixture to three pounds milk produced.

Ration 8.—Potatoes, 20 lbs., brome hay or western rye grass, 10 lbs., alfalfa, 5 lbs., oat straw, 10 lbs., wheat chaff, 5 lbs. Meal mixture; Bran, 300, oats, 300, barley, 200, oil cake meal, 200. Fed one pound meal mixture to three pounds milk produced.

Ration 9.—Brome hay, 12 lbs., alfalfa, 5 lbs., oat straw, 10 lbs., wheat chaff, 5 lbs. Meal mixture: Oats, 500, barley, 200, frozen wheat, 200, flax, 200. Fed one pound meal mixture to three pounds milk produced.

Ration 10.—Oat sheaf, 15 lbs., brome or western rye grass hay, 10 lbs., oat chaff, 5 lbs. Meal mixture: Oats, 500, small wheat, 200, barley, 200, flax, 200. Fed one pound to 2½ pounds milk produced.

SOME NOTES ON FEEDS.

The tables of feed composition as given further on in this bulletin may serve a useful purpose.

Knowledge of the composition of a feed is, however, of very little use excepting there be added to that knowledge, information as to palatability, as to suitability for certain purposes, as to influence on the digestive organs or as to its effect upon the article being produced for sale, whether flesh, milk, cream, cheese or butter.

The notes which follow make no claim to being exhaustive but are, for the most part, as comprehensive as will ever be found necessary to enable the average dairy farmer to feed his cattle to the best advantage both as to cost of feed and quality and quantity of product.

CONCENTRATES OR MEALS.

BARLEY.

Barley when well ground and mixed with other and lighter meals has proven to be a valuable feed for milk production. It is held to have a good effect upon the flavour of dairy products, although the writer has never been able to satisfy himself that such was the case. It is usually a profitable food for cows but must always be fed cautiously and should never constitute more than half the meal ration. The other meals most suitable to feed along with it are bran, oats, oil cake and corn.

BREWERS' GRAINS.

The malt grains freed from the dextrin and sugar are known as brewers' grains. They are often sold to the local trade in the wet form, and are then valuable only for immediate use, as they do not keep. They are not injurious to cows, as claimed by some, but make a very good food when mixed with corn, oats or barley.

BREWERS' GRAINS (DRIED).

A very valuable and easily stored cattle feed can be got by removing some of the excessive moisture from wet brewers' grains, when a feed containing a fair quantity of protein, carbohydrates, and fat is obtained. Four or five pounds per cow per day along with corn, oats, or barley and small quantities of oil cake meal or gluten meal will give good results in milk production.

BUCKWHEAT.

Buckwheat for dairy cows is rarely used in Canada outside the Maritime Provinces. It has a fair feeding value. When ground and mixed with other concentrates it usually cheapens the ration and frequently seems to increase the flow of milk. It is sometimes supposed to injuriously affect the flavour of milk.

BUCKWHEAT BRAN.

This is the name usually given to the mixture composed of the buckwheat hulls and that portion of the grain immediately within the hulls. The latter is a very good feed, rich in protein, but the hulls have practically no feeding value.

CORN.

Corn is an excellent feed for dairy cattle. It is a concentrated source of nutriment, extremely palatable, easily masticated and readily assimilated, but should never make up more than one-half to three-fifths of the concentrate part of the ration. Poor in protein but rich in digestible carbohydrates, it should always be ground and fed along with some other grain rich in protein and light in character, such as bran, shorts or crushed oats. Corn and cob meal is better for dairy feeding than corn meal alone or as the chief part of the meal ration. Pure corn meal is rather heavy but if mixed with cut feed can be fed in considerable quantities. Its great value lies in its easy and almost complete digestibility.

CORN OIL CAKE.

Corn oil cake consists of the pressed germs freed from most of the oil they carry. It is rich in ether extract, or fat, and protein. It should never be fed in large quantities and always mixed with feeds such as bran or oats, or a mixture of other light meals.

CORN BRAN.

Corn bran has about the same feeding value as good straw. It contains about one half less protein than wheat bran but more carbohydrates and fat. It feeds well with gluten meal. Only when low priced can it be fed with profit.

COTTON SEED MEAL.

Cotton Seed meal, as sold on the Canadian market, is of very variable composition. It frequently contains considerable hull and much fluffy, fibrous material. Such meal is of low feeding value and need not be expected to give good results.

Cotton Seed meal of good quality, that is, free from hulls and fibre, is, however, an excellent feed for dairy cows, when fed in conjunction with other and lighter meals such as oats and bran. It is, as a rule, not very acceptable to cattle at first, but is soon eaten with apparent liking. It is usually as well to feed from two to three or at most four pounds only of this meal a day, along with other concentrates. Larger quantities may injuriously affect the health of the animals.

Cotton Seed meal is one of the few feeds likely to in any way affect the character of the fat in the milk produced. As observed elsewhere, oil cake meal fed freely will usually induce the production of softer fats or softer butter. Cotton Seed meal, however, has the opposite effect, as it will, if fed freely, cause the cow to produce harder fats or firmer butter.

DISTILLERS' GRAINS.

From experiments it would appear that dried distillers' grains are better milk producers than oats. They are worth about 50 per cent more than bran, depending, of course, upon their quality. According to German experiments, they will produce about 12 per cent more milk and 9 per cent more fat than oats. Our experiments here indicate an even higher relative feeding value than the German experiments point to.

EMMER.

Emmer and speltz, as to their nutritive properties, are more nearly allied to barley than to oats, but in practice they have about the same feeding value pound for pound as oats. They are always ground together with the hulls, and may enter in large quantities—

one-half or more—in mixture with other grains. Where the rain fall is so low as to make it difficult to grow oats and barley, emmer and spe'tz frequently do very well.

FEED FLOUR.

When feed flour can be had at reasonable prices, it is a good feed for milk production as it contains a high percentage of carbohydrates and fat. Objection is sometimes made to its stickiness. To overcome this, it should never be fed alone and always in small quantities and thoroughly mixed with bran or with some other feeds rich in protein and light or loose in character.

FLAXSEED.

On account of the high commercial value of the oil, flaxseed is not extensively used as cow feed. It contains a considerable quantity of protein with an excess of oil, but very little starch. Steeped till it forms a gelatinous mass, it is of great value as a feed for calves on skim milk. It may be used as above either whole or ground. Mixed in small proportions along with coarse grains and ground, it adds greatly to the palatability and wholesomeness of the meal ration. It should very seldom constitute more than about one-fifth of the grain mixture and one-tenth is usually an effective proportion

GLUTEN FEED.

Gluten feed, as contrasted with gluten meal, contains more coarse residues from the manufacture of starch from corn. The effect of the addition of more or less hull or skin of the kernel is to render the by-product more open in character, lighter in weight and less rich in protein, hence of lower feeding value. Gluten feed is worth about the same as wheat bran from the milk production standpoint, but is not nearly such a safe feed to use. Gluten feed, like gluten meal, varies greatly in composition and should be bought subject to analysis.

GLUTEN MEAL.

A by-product of the manufacture of corn in starch and glucose factories, gluten meal is rich in protein and has a feeding value about equal to oil cake. It should be fed mixed with either bran or oats. It is susceptible of adulteration and should be bought only on guaranteed analysis. Some gluten meal will show over 30 per

Flavia II. of Ottawa. A cow with a good sort of record, (see page 37).

cent protein and may go as high as 35 per cent. When showing over 30 per cent protein it is worth from 30 to 40 per cent more than wheat bran.

HORSE BEANS.

Horse beans are not much grown in Canada. They are rich in protein and enter very well into mixtures with bran, oats or corn, but no more than two or three pounds per cow per day should be fed.

MALT SPROUTS.

In the process of malting, the seeds are allowed to germinate; the germination is arrested at a certain stage and the seeds dried. The sprouts are broken off and separated from the grain and dried, in which form they are sold for feeding purposes. Malt sprouts are relatively rich in protein, 50 per cent more so than bran, but low in carbohydrates and fat. This feed is not much relished by cattle, and can only be fed in limited amount. It should be soaked for several hours before feeding and mixed with ground corn, barley or bran and never more than 2 to 5 pounds per day be fed. It is well to secure a sample for trial before buying.

OATS.

Oats of various varieties are fed very extensively by dairy farmers. They have proven themselves to be fairly satisfactory as a milk-producing feed. It is, however, as a flavouring or palatability increasing constituent of the meal ration that they are most worthy of consideration. When finely ground, as should always be the case, a small proportion in the meal mixture adds very materially to its effectiveness. No other single grain or meal ration will give as good results as oats. They are, however, usually so high in price as to prevent their being so used. In any case, they do better when mixed with some other grain or meal. The other meals most suitable to feed along with them are bran, oil cake, cotton seed, barley, peas and corn.

OAT HULLS.

Oat hulls are low in nutritive value but not unpalatable to the cow. When they contain any portions of the grain, broken kernels, or oat dust, as they practically always do, they have a considerable

value as a flavouring feed and are worth probably half as much as crushed oats or even more. They give best results when dampened before feeding.

OIL CAKE MEAL.

Oil cake should always be on hand. It is a very palatable feed and has a beneficial effect on the digestive tract. It serves as an appetizer and laxative as well as a concentrated source of protein. Its general effect is to place the animal in fine condition, with a pliable skin, sleek coat and good quality of flesh. It should be fed in amount not over two or three pounds per 1,000 lb. cow per day along with some other meals such as bran, corn or oats or a mixture of the three. Milch cows fed freely on this meal are likely to produce soft fats in their milk, or milk that, if churned, will yield a soft butter.

PEAS.

Peas being very heavy and very rich in protein, are suitable for mixing with lighter meals. They are palatable and easily digestible. The high price at which they are usually sold does much to prevent their more extensive use. They are suitable for feeding along with oats, bran or corn. Fed in moderation and along with oats, calves do well on them.

PEA HULLS.

Pea hulls are practically worthless as feed for milch cows. They are dry in nature and almost destitute of the best nutritive material. When very low in price, they might be fed to cheapen the ration, as they are light and fairly palatable.

RYE.

Rye is not much used for cattle feed in Canada. It has been fed in Denmark and is reported to have a deleterious effect on the quality of butter. When used at all, it should always be fed in small quantities, ground and mixed with bran, oats or corn.

SHORTS OR MIDDLINGS.

This is a by-product of the manufacture of wheat flour and is a valuable feed if obtained without the addition of mill dust and other adulterations. About equal to bran in dry matter and protein content and rather higher in carbohydrates, it is somewhat 'heavy' as a feed, and should be mixed with corn or oats.

SOY BEANS.

Soy beans are grown in very small quantities in Canada and then usually as a forage crop. As a meal feed for dairy cows they are practically unknown here but, when available, are very valuable if mixed with other concentrates. They are rich in protein and oil. Cows must be accustomed to them to eat them readily. They should be fed along with bran, oats or corn, but in moderation, since they have a laxative effect and tend also to soften the butter.

WEED SEEDS.

Weed seeds, being the residue from mill screenings, contain a great deal of dust with all kinds of chaff as well as many evil-smelling and worse-tasting seeds which are not always a safe feed for dairy cattle. Feeding at intervals, in small quantities, ground and mixed with other feed, turns to profit an otherwise waste material. Some weed seeds are very rich in oil, in protein or in carbohydrates. It is, however, safer to feed them to sheep, swine or poultry, and always in the ground state.

WHEAT.

Wheat as a feed for dairy cows is almost unknown in Canada. Where tried it has proven satisfactory. To give the best results, it must be rather finely ground and fed along with other meals. The other meals most suitable to feed with it are wheat bran, oats, oil cake and corn. Frozen wheat, when available, is a first-class feed for dairy cows. It should be finely ground and should not make up more than half the meal mixture. Oats and wheat bran are suitable for mixing with frozen wheat.

WHEAT BRAN.

As a concentrate feed for dairy cattle, all things considered, wheat bran has no equal in Canada to-day. It is good combined with other meals such as oats, corn, barley, pea, gluten, oil cake or bean meal. It comes nearest to making a successful meal ration of any concentrate fed alone. Furnishing, as it does, protein and ash, which are essentials in milk production, and also some amount of starchy matter, it should enter into every meal mixture intended for dairy cows. Being exceedingly wholesome, easily digestible and very palatable, it may constitute any part or even the whole of a profitable dairy meal ration.

Wheat bran is about of equal feeding value with a mixture of barley and oats, and is very little inferior to oats alone, which are usually very much dearer pound for pound. It is mildly laxative.

Bran, as offered on the Canadian market, is frequently adulterated with crushed weed seeds or the hulls thereof, which greatly detract from its value.

HAY FROM CLOVERS AND GRASSES.

ALFALFA OR LUCERN.

In many parts of Canada, three cuttings of alfalfa hay may be made each summer. It is seldom indeed that it is not possible to harvest from the alfalfa field two good large crops of a forage that for palatability, high feeding value and low cost of production is without an equal. This forage plant, so far but little known to Canadian dairymen, will undoubtedly come to its own in the near future. It is as a feed for dairy cows that it is most worthy of consideration but all classes of stock do well on it, and young cattle and calves do exceptionally well when fed therewith. When cut at the right stage (just starting to blossom) and properly cured, it is equal to good wheat bran, pound for pound.

(For instructions how to grow, see Experimental Farm bulletin No. 46 and Second Series bulletin No. 8.)

ALSIKE CLOVER.

Alsike clover is not usually sown alone for forage purposes. Mixed with red clover in the proportion of 2 to 3 pounds to 10 pounds red clover per acre, it has a most satisfactory effect upon both the quality and the quantity of hay produced. It grows well on moist land, and its stand for several years from one seeding makes it valuable in pastures and in mixed meadows that it may be desired to leave down for more than one year.

BROAD LEAF MARSH HAY.

Some claim broad leaf hay to be very nutritious, others say it is not very high in feeding value. Each statement has some truth in it. Its value depends, to a great extent, on the place where it has grown and the manner in which it has been cured. Some samples from the Maritime provinces analyzed here (C.E.F.) were found to be poor in albuminoid and high in fibre. Other samples from the

West have shown up somewhat better. In any case, it adds to the bulk of the roughage supply and is especially useful when there is a shortage of other more highly nutritive roughage.

BROME GRASS.

In many places, brome grass is looked upon as a weed on account of the thick sod it makes being difficult to plough and almost impossible to kill. For these reasons, it should be sown only on land intended for permanent pasture. As a pasture grass, it is a high producer, and is relished very much by cattle, being rather more palatable than timothy. If intended for hay it should be cut as soon as the blossoms have fallen, when it makes hay of good quality and superior to timothy in palatability and nutritive value. It is laxative in effect and is therefore an exceedingly valuable hay for districts or on farms where succulent forage is scarce for winter use.

CANADIAN BLUE GRAS

Canadian Blue grass is somewhat similar to Kentucky Blue grass in habit and usefulness. It makes a good, nutritious and abundant pasture, but on account of its low habit of growth is not used much for hay. It does not form such a dense turf as Kentucky Blue grass, but will grow on poorer and drier soils.

FESCUE.

The Tall Fescue and Meadow Fescue are perennial plants and among the best adapted to cultivation in Canada. Both are perfectly hardy and produce heavy crops of good quality. They also provide excellent pasture in early spring and late autumn. These nutritious and productive grasses should always be included in permanent pasture mixtures.

HUNGARIAN GRASS.

A valuable grass for catch crop owing to its rapidity of growth. It succeeds well on dry light land and produces a heavy crop of hay, which is very nutritious when it has been sown thickly and cut early. It is not among the best grasses, rapidly deteriorating as it matures, so as to be practically worthless when ripe. The young crop, however, furnishes a wholesome and valuable fodder.

KENTUCKY BLUE GRASS.

Kentucky Blue grass is the most valuable of the grasses. It makes the best pasture of any grass during the early part of the season, but does not withstand drought very well. The leaves, which are numerous, are sweet, nutritious and rich, containing much protein. In a permanent pasture, Kentucky Blue grass forms, after a year or two, a very dense turf. As a hay crop it is not recommended on account of the shortness of the plants and the small amount of aftermath.

MILLETS.

Millets are used mostly as soiling crops but make excellent hay. Their rapidity of growth, large yield, great palatability and high feeding qualities make them valuable forage plants. To give satisfaction as hay, the millet must have been sown thickly, 50 to 60 pounds per acre, and must have been cut just as the heads were appearing. When so handled, the forage is largely freed from coarseness and is much more digestible.

OAT HAY.

Green oats are made into hay with profit only when there is a shortage of other hay or when the crop lodges badly and the grain is not likely to ripen satisfactorily. For hay making, oats should be cut in the early milk stage while the leaves and stems are still bright and clean and before any signs of ripening appear. Oat hay is cured the same as ordinary hay and fed out with the grain unthreshed and either mixed with ensilage or by itself. Cut with the binder and cured in shock it makes a cleaner and more acceptable forage but there is, of course, less of it.

OAT AND PEA HAY.

This is one of the best forage crops grown. It is valuable on account of its high nutritive qualities and its large yields per acre. It is rich in protein and very palatable. In choosing varieties of seed to sow together, a variety of oats which will be in the milk stage when the peas are in full bloom should be chosen, for this is the best time to cut the crop for hay.

ORCHARD GRASS.

Orchard grass is a rather coarse grass, which grows in tufts, being particularly suitable for orchards or other shady places. When young, it is very succulent, and its chief value is as pasture grass, though, cut early before it becomes coarse and woody, it makes a fair hay. In mixtures for pastures it is very valuable on account of its early and late growths, and its ability to withstand drought.

RED CLOVER.

For cows in milk and young stock, red clover is one of the best of forage feeds. It is especially rich in the protein and ash constituents so essential to milk production. It is also very palatable and much relished by cattle and is an excellent supplementary feed where corn ensilage or mangels constitute the succulent part of the ration. To get the best results from red clover hay, the seed should have been sown very thickly, say 12 to 15 lbs. per acre, and the hay cut in full blossom before any brown heads are in evidence. Clover hay made in this way from thick stands of clover is worth anywhere from 50 per cent to 100 per cent more than late-cut hay from thin, coarse-growing clover meadows. In pasturing cattle on clover, care should be taken to avoid bloating (see under 'Soiling Crops'). In many parts of Canada, red clover is a biennial but west of Lake Superior wherever it can be grown and more particularly in British Columbia, it is apparently perennial.

RED TOP.

Red top is one of the hardiest and most long-lived of grasses, and so should be always included in mixtures for seeding pastures which are to be left for a time in grass. Red top grows well on rich, moist land; it makes a good pasture grass when grazed in its early stage. It is also valuable as a hay crop, blossoming at the same time as timothy, with which it may thus be sown.

SLOUGH HAY.

It is a tall, coarse grass of the West, making remarkably soft hay, growing in wet sloughs. It grows abundantly, and, if cut early, soon after the heads appear, forms valuable fodder much relished by cattle. It contains more albuminoids and carbohydrates than timothy.

SWEET CLOVER.

Sweet clover (or melilot, whose seed is sold on the market under the name of Bokhara clover), is a biennial plant, looked upon as a weed in most places. Owing to its bitter taste, it is not much relished by stock. They can, however, be taught to eat it. To be palatable, it must be cut very early, because it makes a fast and rank growth and soon becomes woody. It will grow on the poorest of soils, and its chief value, therefore, would seem to lie in its manurial qualities. It is now being sown in clover mixtures for meadows. The white variety is the most prolific and the most succulent.

TIMOTHY.

When cut on the green side and well cured, timothy is much liked by cattle and gives fairly satisfactory returns. It is, however, usually too coarse and dry to be as well liked as a forage should be to give good results. In addition to this fault, it is, in composition, suitable for fattening rather than for producing milk and should be fed dairy cattle only when other more suitable forage is not available. It is, however, when cut at the right stage, viz., early blossoming, a highly digestible and very nutritious forage.

VETCH HAY.

Vetch hay is a good and palatable feed for dairy cows, being high in nutrients, especially protein. The best materials to be fed along with it are roots, corn and oats. Neither oil meal nor a great quantity of bran is necessary.

WESTERN RYE GRASS.

This grass has succeeded remarkably well under cultivation and is one of the best western hay grasses, producing a large number of leaves and a straight, slender stem. It is an early grass and does well on heavy soil even when impregnated with alkali. It is very nutritious.

STRAW AND FODDER CORN.

CORN FODDER.

Corn fodder is the name given to the whole corn plant harvested with the ears on. It is a very valuable feed when fed alone, but one which does not lend itself to exactness, for it is impossible to pro-

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Jersey Cow—Rosalind of Old Basing. Produced 15,700 lbs. milk and 825·51 lbs. fat in 1 yr.

Jersey Bull—Noble of Oaklands—Sold at public auction for $15,000.

perly regulate the daily allowance of grain. It is difficult to feed such material in mangers, unless the stalks are cut. Alfalfa or clover is good to supplement corn fodder in feeding.

CORN STOVER.

Corn stover is the name given to the whole stalk of corn after the ear has been taken off. It is frequently fed to dairy cattle, and, shredded and mixed with cut alfalfa, bran, corn, oats, barley or peas, it makes a fairly valuable feed. Shredding adds value to it as it is thereby more easily handled and stored, and more readily eaten by the cattle. If shredded and stored in large quantities, a silo is necessary to preserve it in good shape.

BARLEY STRAW.

Barley straw has a feeding value not much higher than that of wheat straw. The best way to use it is finely cut, mixed with clover and soaked with water for a short time, or mixed with ensilage and allowed to stand for a day or two before using. When so prepared, it has nearly the value of oat straw.

BUCKWHEAT STRAW.

Buckwheat straw has some feeding value, owing to the nitrogen it contains. It is more suited for sheep than for cow feeding.

CHAFF.

Chaff of wheat and oats is a fairly valuable feed, containing, as it does, more protein than the straw. Mixed with pulped roots, and allowed to stand until fermentation begins, chaff is a very good feed, quite palatable to dairy cows.

FLAX STRAW.

There is some record of flax straw being fed to cattle with satisfactory results. Possibly it has more nutritive value than oat straw, especially when some flax seed is left in it, but it is not very palatable because of the stringy twine-like covering of the stems which is difficult to digest.

OAT STRAW.

Oat straw is successfully utilized when fed in combination with some other roughage and grain. It contains a great deal of fibre

and indigestible matter, but adds a good deal of mineral matter to the ration. It is an excellent 'filler' and, though not likely to add materially to the value of a ration on account of its nutritive qualities, it is of great value in helping distend the digestive organs and so facilitating and even aiding digestion. Of all straws in Canada, oat is undoubtedly the best for cattle.

PEA STRAW.

Clean pea straw is of considerable value for cattle feeding. It is, however, usually very dusty and badly broken up, which conditions very greatly reduce its value as a forage. It is excellent sheep feed.

WHEAT STRAW.

Wheat straw is very low in nutrients. It is dry, coarse and unpalatable, and has very little digestible matter. It may, however, be fed in small quantities to dry stock whenever there is a shortage in the roughage supply.

SOILING CROPS.

In growing soiling crops, provision should be made for a succession of such for continuous feeding. Fall rye and fall wheat, followed shortly by alfalfa, will be the earliest, perhaps 3 or 4 weeks before pasture grass is ready. In quick succession come red clover, vetches, oats, beans and corn. Roots come late in the fall. To tide over any possible period between crops, ensilage could be used.

ALFALFA.

As a soiling crop, alfalfa is without a peer. It is ready for use earlier than any other soiling crop possible of cultivation in Canada save only fall rye and winter wheat. It starts to grow again immediately it is cut and furnishes two, and frequently three, heavy cuttings in the season. It is not so readily affected by weather conditions as other soiling crops and demands much less labour to keep in shape year after year. For methods of growing see Dominion Experimental Farm Bulletin No. 46 and second series Bulletin No. 8.

CLOVER.

For soiling purposes, clover holds an important place since the crops is ready early in the season, provides an abundance of succulent feed, and is very much relished by cattle. The best soiling variety is red clover, and the best mixture is Mammoth and Alsike. Clover should be cut a few hours before feeding to prevent any possible injurious effect from bloating. Should it be found desirable to pasture the clover field at any time, care should be taken to guard against bloating by giving the cattle all they will consume of some other kind of food before letting them into the clover field. This should be done to a certain extent for several days. Later, when the cattle become accustomed to the forage, it will be sufficient to see that they are not unusually hungry and that the clover is not wet with dew or rain.

CRIMSON CLOVER.

Crimson clover is an annual plant. As a fall-sown crop it is unsatisfactory in many parts of Canada because it does not always come through the winter successfully. It can, however, be grown to advantage in Nova Scotia, British Columbia and some parts of Ontario. Sown in the spring it makes a fairly good soiling crop, but is a somewhat dangerous feed on account of the small, stiff hairs or bristles on the heads which gather into balls in the stomach of the animal.

CORN.

This is one of the most succulent forage plants that can be grown for soiling. It has a palatability and succulence surpassed by no other feed and the large amount of food it will yield per acre adds greatly to its other qualities. The way to feed it with as little labour as possible is in the form of ensilage. If an excess of what is needed for winter use be put into the silo in the fall, it can most advantageously be used for summer feeding. Corn can be sown in the early spring and be fed in the stable in late summer.

HAIRY VETCHES.

These vetches, however good they may be, cannot be sown alone on account of the weakness of their stems. With a crop of oats or barley as support, they make an excellent soiling crop, as good as

peas and oats or even better. The seed is, however, exceedingly expensive and there is very little probability of this crop being grown to any appreciable extent in this country.

OATS.

Sown alone, oats are not recommended for soiling. Mixed with peas or vetches, however, they will produce large yields of green feed per acre and rank next to corn in palatability, succulence and milk-producing value. When sown at intervals of from 12 to 15 days, they can be made to last as long as necessary. The best time to have them ready is July and August, when pasture grass is dry and scarce.

RAPE.

As a soiling crop for cows in milk, rape is not likely to become very popular since it is sure to flavour the milk unless fed with the greatest care and in moderate quantities. It is, however, exceedingly acceptable to dairy cattle and is sure to increase the milk flow. It is best suited for the feeding of dry cows, heifers, steers, sheep or swine. For methods of growing see Dominion Experimental Farm Bulletin No. 42.

RYE.

Rye in this country is not much used for soiling. It is, however, when cut at the right stage, much relished by cows but is said to impart a bad flavour to the milk. If fed in moderation along with other feeds, it is not likely to perceptibly affect the milk in any way. Rye sown in the fall will provide a large amount of feed early in the summer, 2 or 3 weeks before grass is ready. Rye sown in August will furnish a small amount of pasture four to six weeks after sowing until winter sets in.

SORGHUM.

Sorghum is a very valuable plant for green feed, especially for milch cows, being very palatable and succulent. It is not yet much used in Canada but in the 'dairying' States it has been found almost indispensable. It gives very large returns per acre.

SOY BEANS.

The soy bean is a very good crop for green forage. Its abundant yield, high feeding value, length of season (it may be fed from

the time the flowers appear until it is damaged in the fall by frost) and its great adaptability to varying soils and climatic conditions make it one of the most valuable. Because of its high protein content it is excellent to feed with materials that are lacking in protein, but rich in carbohydrates. Cattle like it fairly well.

VETCHES.

Common vetches are an excellent soiling crop. They are particularly adapted to sandy soil. When sown in the early spring, they will give an abundance of fairly succulent feed about the end of July or August. They are as nutritious as clover and are relished by cattle even more.

WHITE CLOVER.

White clover is never sown alone but always in mixtures intended for pasture and, when pastured, it gives a thick growth of leaves till late in the fall. It does very well on heavy soils.

ENSILAGE CROPS.

CORN, SUNFLOWER, AND HORSE BEAN SILAGE.

This mixture, commonly known as 'The Robertson Mixture,' gave good results on the Central Experimental Farm, where it was first tried. As to yield per acre, quality and quantity of digestible matter contained in the whole, it has proved especially suited for feeding dairy cows. There are, however, some strong doubts as to the practicability of harvesting these crops when grown together. Horse beans are rather weak plants with short stems as compared to corn and, when grown together, it is very difficult to cut both clean with the binder. In the case of sunflowers, only the heads are of any feeding value, the stems are coarse, woody and hollow, and almost indigestible, which renders them objectionable in silage making. It is considered better, therefore, to grow these crops separately.

This combination of corn, horse beans and sunflowers gives a forage which approaches very nearly the balanced ration, supplying carbohydrates, proteins and fats in effective proportions. The mixture, however, has not proven very popular anywhere, on account of difficulties met with in growing the sunflower and horse bean.

CORN ENSILAGE.

Good corn ensilage is fairly high in feeding value, and this, combined with its advantages over other succulent feeds in the matter of cheap production and labour-saving in using, has rapidly brought it to the top of the list of Canadian forages. At relatively low cost, a large amount of corn can be produced, stored up in the silo in the fall, and used any time during the winter or even in summer in place of soiling crops (see Dominion Experimental Farm Bulletin No. 65, for instructions how to grow). When cut fine there is practically no waste, and owing to its succulence or juiciness it is eaten freely. It may constitute the principal part of the ration of any class of horned cattle and for dairy cows is easily the cheapest and most convenient forage material possible of production over a very large part of Canada. It may be fed in large quantities without fear of any injurious effects, save in the case of very young calves or hard-working stock bulls. It should, generally speaking, have intermixed with it, 12 to 36 hours before feeding. from 10 to 15 per cent cut straw or chaff, oat chaff preferably

RAPE.

Because of its watery nature, rape cannot be used for ensilage with any great advantage. It will keep satisfactorily and is very palatable but can be used for dry cattle only, as it makes a very highly-flavoured and exceedingly odorous brand of ensilage.

HORSE BEANS.

The horse bean is a very valuable feed where it can be properly grown. In the dairying districts of Great Britain it is one of the staple feeds. It has, however, not been grown very successfully in Canada, except in a few places, and there it is highly priz

SORGHUM.

Sorghum as silage gives only fair satisfaction. It is inferior to corn in feeding value, containing less protein and more carbohydrates (sugar). This excess of sugar, when fermenting, develops more acetic acid than does corn and causes the silage to become injurious to the health of animals if fed in large quantities. Corn and sorghum may be mixed with good results.

CLOVER.

Among the clovers, the Mammoth or Common Red varieties mixed with alsike are the best for silage purposes. When cut in blossom and run through the feed cutter, they can be ensiloed to best advantage, and give a very good quality of feed ready to use at any time, and even to take the place of soiling crops in summer when grass is scarce. In value it comes next to corn both as to succulence and milk-producing qualities.

PEAS AND OATS.

Peas and oats make a good quality of ensilage when cut fine and thoroughly packed. Unless it is well packed so as to drive out nearly all the air it will not keep. It must, in addition, have been cut at an early stage, say when the oats are in the milk. It had better be mixed with clover, alfalfa or corn to insure good results.

ROOTS AND POTATOES.

MANGELS.

Mangels are among the best feeds that can be fed cows in milk. They are exceedingly palatable, easily digestible and very nutritious. Where pulped and fed along with cut dry feed they add greatly to the value of the latter. They have the effect of hardening the butter slightly and are said to affect favourably the flavour of the milk and cream. Much has been said about their value as a substitute for meal in feeding dairy cows. They are, no doubt, of some value as decreasing the quantity of meal necessary, but need not be expected to replace the meal ration to any great extent. Their great value lies in their remarkable palatability or acceptability to dairy cows. A cow refusing to eat almost any other kind of feed will greedily eat quite a considerable quantity of this most valuable root.

Of the three types commonly grown, the Long Red or Gate Post, the Tankard or Half Long and the Globe, the Long Red is usually the most prolific cropper as well as the most nutritious.

(For methods of growing, etc., see Experimental Farm Bulletin No. 67).

POTATOES.

The potato is high in nutritive constituents but usually commands such a good price for table use that it is seldom used as a

forage crop in Canada. However, the farmer who grows potatoes has usually the small, unmarketable tubers which he may feed to his stock. At times, also, he might consider it advisable to feed much of his general crop rather than put it on the market when prices were very low. Marketable potatoes should seldom be fed whole to cattle, but should be either sliced or pulped. Raw potatoes, if fed in too large quantities, cause scouring. The potato, though to judge by its chemical composition of rather low feeding value, is really a most excellent cattle food and, if fed in moderation, gives excellent results as a milk-producing forage.

RUTABAGAS OR SWEDES.

Swedish turnips or Rutabagas are not recommended for milch cows because of the flavour they impart to the milk. They are, however, excellent for fattening purposes or winter feeding of heifers, calves, etc. If they must be fed to milch cows, they should be given just after milking, as then there is less likelihood of their tainting the milk. They are much relished by cattle either fed alone or mixed with other feeds.

SUGAR BEET.

The deep-growing habit of the sugar beet and the consequent difficulty of harvesting it, together with the danger of scour, make this crop of less value as a cattle feed than mangels. If fed in moderation, however, they make a most excellent dairy feed. They are much liked by dairy cows and when used to replace an equal quantity of other roots or corn ensilage, have the immediate effect of materially increasing the milk flow. They should be pulped or sliced. (See Experimental Farm Bulletin No. 67).

SUGAR MANGELS.

Sugar mangels are supposed to be a cross between the sugar beet and the mangel-wurtzel or the common mangel. They are, however, at the present time but slightly different in feeding value from the mangel, and since they do, as a rule, yield less per acre, are not to be recommended as in any way superior to or even equal to the Long Red or Gate Post mangel. (See Experimental Farm Bulletin, No. 67).

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Holstein Cow—Colantha 4th's Johanna. Produced 27,432·5 lbs. milk and 998·26 lbs. butter fat in 1 yr.

TURNIPS.

Flat turnips or white turnips are softer and more watery than the swedes and do not keep so well; they cannot be stored for any length of time.

They can hardly be recommended for cows, but are less likely to injuriously affect the flavour of the milk or cream than rutabagas. They are frequently used as a soiling crop for dairy cattle, with quite satisfactory results.

VARIOUS FEEDS.

APPLES.

Apples have been found to be fairly satisfactory as a feed for dairy cattle, possibly not so much because of the nutriment they afford as on account of their palatability and health-giving qualities. When fed apples, cattle seem to eat more of other food, seem to increase in digestive capacity and in power of assimilating a greater quantity of grain per day with a consequent increase of profit. Refuse apples should be fed in addition to the regular ration and not to take the place of anything in the ration.

APPLE POMACE.

This feed is a by-product of the cider industry. It is a pulp-like product with a value somewhat less than apples. It has the same properties as apples, but to a less degree. It has no injurious effect but should be fed when fresh and always as an addition to the regular ration and not to take the place of any part.

CABBAGE.

For feeding dairy animals, the cabbage is one of the most palatable plants and would probably be used a great deal more extensively were it not for the difficulty of storing and also for the danger of tainting the milk. It is very valuable as a soiling crop, but should be fed immediately after the cows have been milked and the milk removed from the near neighbourhood.

CONDIMENTAL FEEDS.

There are on the market many feeds which are claimed by their manufacturers to be beneficial to cattle as tonics or medicines. Tests of these have been made frequently. and no benefit whatever

seems to be derived from their use, a fact which is not surprising when it is known that, as a rule, these feeds are merely compounds of the ordinary feeding stuffs coloured and flavoured according to the taste of the manufacturer. It is safe to say that these condimental feeds are far from being worth the high prices which are usually asked for them.

DRIED SUGAR BEET PULP.

The dried pulp from beet sugar factories makes a good feed for milk production. It can scarcely be classed as a concentrate but is much superior in composition to most forms of roughage. Probably its greatest value to the dairy farmer would be found when it was used as a substitute for succulent feed after being soaked for 12 hours in from four to five times its own weight of water and then used as a succulent base wherewith to mix oat chaff and other dry and more or less unpalatable roughage as well as whatever meal is being fed. When so used, it acts not only as a feed but as an aid to palatability as well as increases the digestibility of the whole ration.

MOLASSES.

Molasses contains about 50 per cent sugar. When it is mixed with other substances, it makes a very nutritious feed which is palatable to all kinds of stock. It should not be fed more than 2 or 3 pounds a day to dairy cows and only about half the quantity to cows advanced in pregnancy. It may be fed with all kinds of cereals. It is usually rather laxative in effect. It adds greatly to the palatability of both roughage and meal. It may be fed to best advantage by diluting 1 to 3 or 4 parts of water and sprinkling on the feed.

PUMPKINS.

This crop, one time grown very extensively along with corn in Canada, has of late years been much less commonly produced, due to the use of the corn harvester and the much longer period of cultivation found profitable in growing corn, whether for grain, forage or ensilage. Where grown, however, the pumpkin has proven to be a most satisfactory feed for milch cows and is worth probably more than an equal weight of roots or ensilage.

SKIM MILK.

Skim milk is of high value as a feed especially to young animals on account of the amount of ash and protein which it can give to the building up of muscle and bone. In its use, care should be exercised to feed it at a uniform temperature and uniformly sweet or uniformly sour. It is sometimes fed to milch cows. As a feed for milk production it has undoubted value but is not worth as much in this connection as when used as a feed for young stock.

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TABLES OF FEED COMPOSITION.

TABLES showing quantities of dry matter, digestible protein and digestible carbohydrates plus fat x 2·25 in 100 pounds of various feeds.

CONCENTRATES.

Feed.	Dry Matter.	Digestible Protein	Digestible Carbohydrates plus digestible fat x 2·25.	Nutritive Ratio.
Concentrates—				
Barley	89·1	8·4	68·9	1 : 8·2
Beans	85·9	20·59	50·15	1 : 2·48
Brewers' grains (dry)	91·8	20·0	45·7	1 : 2·28
Brewers' grains (wet)	24·3	4·9	13·22	1 : 2·7
Buckwheat	86·6	8·1	53·60	1 : 6·6
Buckwheat shorts	87·2	22·7	51·22	1 : 2·2
Corn and cob meal	84·9	4·4	66·5	1 : 15·1
Corn meal	85 0	6·1	72·2	1 : 11·8
Cotton seed meal	93·0	37·6	43·0	1 : 1·14
Distillers' grains (mostly rye).	92·4	22·8	65·8	1 : 2·9
Feed flour (Red Dog)	90·1	16·2	64·7	1 : 4·0
Flax seed	90·8	20·6	82·4	1 : 4·0
Gluten feed	90·6	17·8	72·1	1 : 4·0
Gluten meal	90·5	29·7	56·2	1 : 1·9
Horse beans	85·7	22 4	52·0	1 : 2·3
Linseed meal (oil cake)—old process	90·2	30·2	47·4	1 : 1·6
Linseed meal (oil cake)—new process	91·0	31·5	41·1	1 : 1·3
Malt sprouts	90·5	20·3	49·2	1 : 2·4
Oats	89·6	8·8	58·9	1 : 6·7
Oat meal	92·1	11·9	80·2	1 : 6·8
Peas	85·0	19·7	51·2	1 : 2·6
Rye	91·3	9·5	72·1	1 : 7·6
Spelt	92·0	10·5	74·8	1 : 7·1
Wheat	89·5	8·8	70·9	1 : 8·0
Wheat bran	88·1	11·9	47·6	1 : 4·0
Wheat screenings	88·4	9·6	52 5	1 : 5·5
Wheat shorts	88·8	13·0	55·8	1 : 4·3

HAY AND DRIED FORAGE.

Feed.	Dry Matter.	Digestible Protein.	Digestible Carbohydrates plus digestible fat x 2·25.	Nutritive Ratio.
Hay and dried forage—				
Alfalfa	91·8	10·5	42·3	1 : 4·0
Alsike clover	90·3	8·4	42·2	1 : 5·0
Broad leaf marsh hay	93·0	2·475	27·13	1 : 10·9
Brome	89·24	3·31	25·57	1 : 7·7
Cow pea	89·5	9·2	42·3	1 : 4·6
Hungarian grass or millet	86·0	5·0	49·4	1 : 10·0
Kentucky blue grass	86·0	4·4	41·8	1 : 9·5
Meadow fescue	80·0	4·2	40·3	1 : 9·6
Mixed grasses and clover	87·1	5·9	43·6	1 : 7·4
Oat hay	86·0	4·7	40·6	1 : 8·6
Oat and vetch	85·0	8·3	38·7	1 : 4·7
Orchard grass	90·1	4·9	45·5	1 : 9·3
Prairie hay	90·0	3·5	45·0	1 : 12·8
Peas and oats (dried)	89·5	7·6	45·0	1 : 6·0
Salt meadow hay or marsh hay	88·3	4·3	27·7	1 : 6·4
Sedge hay	91·25	2·7	22·5	1 : 8·3
Red clover	84·7	7·1	41·9	1 : 5·9
Red top	91·1	4·8	49·5	1 : 10·0
Slough hay	88·4	2·4	31·9	1 : 13·3
Sweet clover (Melilotus alba)	92·1	11·9	37·8	1 : 3·2
Timothy, cut full bloom	85·0	3·4	46·6	1 : 13·7
Timothy, cut soon after bloom	85·8	2·5	42·6	1 : 19·0
Timothy, cut nearly ripe	85·9	2·1	42·6	1 : 20·3
Timothy and clover	87·1	3·8	42·8	1 : 11·3
Western rye grass	86·0	6·1	40·5	1 : 6·6
White Daisy (Ox-eye Daisy)	89·7	3·7	44·8	1 : 12·1

STRAW, CHAFF AND DRY FODDER.

Feed.	Dry Matter.	Digestible Protein.	Digestible Carbohydrates plus digestible fat x 2·25.	Nutritive Ratio.
Straw, chaff and dry fodder :—				
Barley	85·8	0·9	41·5	1 : 46·1
Buckwheat	90·1	1·20	38·50	1 : 32·1
Flax	88·8	0·88	17·2	1 : 19·5
Oat	90·9	1·3	41·3	1 : 31·8
Oat chaff	85·7	1·5	34·6	1 : 23·0
Pea	85·7	4·3	31·1	1 : 4·6
Rye	92·9	0·7	40·5	1 : 57·9
Wheat	90·4	0·8	36·1	1 : 45·1
Wheat chaff	85·7	1·2	26·7	1 : 22·2
Dry fodder :—				
Corn stover	59·5	1·4	32·8	1 : 23·4
Dry ensilage corn or dry fodder corn	57·8	2·5	37·3	1 : 14·9

ENSILAGE AND ROOTS.

Feed.	Dry Matter.	Digestible Protein.	Digestible Carbohydrates plus digestible fat x 2·25.	Nutritive Ratio.
Ensilage :—				
Corn	26·4	1·4	15·8	1 : 11·3
Corn and soya beans	24·0	1·6	14·6	1 : 9·1
Clover	28·0	1·5	10·3	1 : 6·8
Sorghum	23·9	0·1	13·9	1 : 13·9
Rye	19·2	0·7	9·5	1 : 13·6
Roots, etc :—				
Cabbage	10·0	2·3	6·1	1 : 2·6
Carrots	11·4	0·8	8·5	1 : 10·6
Mangels	9·1	1·1	5·9	1 : 5·4
Potatoes	20·9	1·1	15·9	1 : 14·4
Rutabagas or swedes	11·4	1·0	8·6	1 : 8·6
Sugar beets	13·5	1·3	10·0	1 : 7·7
Turnips (flat)	9·9	1·0	6·6	1 : 6·6

GREEN FEED.

Feed.	Dry Matter.	Digestible Protein.	Digestible Carbohydrates plus digestible fat x 2·25.	Nutritive Ratio.
Green feed—				
Alfalfa	28·2	3·9	13·8	1 : 3·5
Alsike clover	25·2	2·6	12·5	1 : 4·8
Blue grass (Kentucky)	34·9	2·8	21·2	1 : 7·5
Cow peas	16·4	1·8	9·2	1 : 5·1
Crimson clover	19·1	2·4	10·2	1 : 4·2
Canadian blue grass	16·1	4·04	7·3	1 : 1·8
Hairy vetches	16·7	3·3	8·4	1 : 2·5
Mixed pasture grass	25·0	2·3	15·7	1 : 6·8
Oat forage (in milk)	37·8	2·5	20·5	1 : 8·2
Oats and peas	20·3	1·8	11·1	1 : 6·1
Oats and vetch	20·0	2·3	10·5	1 : 4·5
Pasture grass	20·0	2·5	11·3	1 : 4·5
Rape	14·3	2·0	8·7	1 : 4·3
Red clover	29·2	2·9	15·2	1 : 5·2
Rye	23·4	2·1	15·0	1 : 7·1
Sorghum	20·6	0·6	12·3	1 : 20·5
Sweet clover	20·0	2·5	9·3	1 : 3·7
Vetches	15·0	1·9	7·0	1 : 3·6
White clover	19·8	2·5	5·65	1 : 2·2

MISCELLANEOUS FEEDS.

Feed.	Dry Matter.	Digestible Protein.	Digestible Carbohydrates plus digestible fat x 2·25.	Nutritive Ratio.
Miscellaneous feeds—				
Artichokes	20·5	1·3	15·1	1 : 11·6
Apples	22·2	0·80	16·9	1 : 21·1
Apple pomace	17·0	0·60	14·2	1 : 23·6
Beet pulp dried with molasses	92·0	6·1	68·7	1 : 11·2
Beet pulp (wet)	10·2	0·6	7·3	1 : 12·1
Beet pulp (dry)	91·6	4·1	64·9	1 : 15·8
Bibby's calf meal	89·6	12·8	83·1	1 : 6·5
Blatchford's calf meal	90·83	21·2	50·1	1 : 2·3
Blood (dried)	91·5	70·9	5·625	1 : 0·08
Frozen wheat	85·2	13·5	69·6	1 : 6·1
Milk	12·8	3·6	13·2	1 : 3·7
Molasses	81·4	8·5	60·5	1 : 7·1
Pumpkins	10·9	1·00	6·25	1 : 6·2
Skim milk	9·4	2·9	5·9	1 : 2·0
Whey	6·6	0·60	5·4	1 : 9·0
Buttermilk	9·9	3·8	6·2	1 : 1·6

RAPID RATION CALCULATION.

As a help to rapid ration calculation, a few of the more commonly-used feeds, with their feeding values, are given below in quantities of from 1 to 10 pounds, or, in the case of succulent roughage, 1 to 50 pounds.

CONCENTRATES.

Name of Feed.	Quantity.	Dry Matter.	Digestible Nutrients.		Nutritive Ratio.
			Proteins.	Carbohydrates. Fats x 2·25	
Barley	1 lb.	0·891	0·084	0·689	
	2 lbs.	1·782	0·168	1·378	
	3 "	2·673	0·252	2·067	
	4 "	3·564	0·336	2·756	
	5 "	4·455	0·420	3·445	
	10 "	8·910	0·840	6·890	1 : 8·20
Bran, wheat	1 lb.	0·881	0·119	0·476	
	2 lbs.	1·762	0·238	0·952	
	3 "	2·643	0·357	1·428	
	4 "	3·524	0·476	1·904	
	5 "	4·405	0·595	2·380	
	10 "	8·810	1·190	4·760	1 : 4·00
Corn meal	1 lb.	0·850	0·061	0·722	
	2 lbs.	1·700	0·122	1·444	
	3 "	2·550	0·183	2·166	
	4 "	3·400	0·244	2·888	
	5 "	4·250	0·305	3·610	
	10 "	8·500	0·610	7·220	1 : 11·80
Cotton seed meal	1 lb.	0·930	0·376	0·430	
	2 lbs.	1·860	0·752	0·860	
	3 "	2·790	1·128	1·290	
	4 "	3·720	1·504	1·720	
	5 "	4·650	1·880	2·150	
	10 "	9·300	3·760	4·300	1 : 1·14
Flax seed	1 lb.	0·908	0·206	0·824	
	2 lbs.	1·816	0·412	1·648	
	3 "	2·724	0·618	2·472	
	4 "	3·632	0·824	3·296	
	5 "	4·540	1·030	4·120	
	10 "	9·080	2·060	8·240	1 : 4·00
Gluten meal	1 lb.	0·905	0·297	0·562	
	2 lbs.	1·810	0·594	1·124	
	3 "	2·715	0·891	1·686	
	4 "	3·620	1·188	2·248	
	5 "	4·525	1·485	2·810	
	10 "	9·050	2·970	5·620	1 : 4·00
Oats	1 lb.	0·896	0·088	0·589	
	2 lbs.	1·792	0·176	1·178	
	3 "	2·688	0·264	1·767	
	4 "	3·584	0·352	2·356	
	5 "	4·480	0·440	2·945	
	10 "	8·960	0·880	5·890	1 : 6·70

Concentrates.

Name of Feed.	Quantity.	Dry Matter.	Digestible Nutrients.		Nutritive Ratio.
			Proteins.	Carbohydrates. Fats x 2·25.	
Oil cake meal new process.	1 lb.	0·910	0·315	0·411	
	2 lbs.	1·820	0·630	0·822	
	3 "	2·730	0·945	1·233	
	4 "	3·640	1·260	1·644	
	5 "	4·550	1·575	2·055	
	10 "	9·100	3·150	4·110	1 : 1·30
Peas.....	1 lb.	0·850	0·197	0·512	
	2 lbs.	1·700	0·394	1·024	
	3 "	2·550	0·591	1·536	
	4 "	3·400	0·788	2·048	
	5 "	4·250	0·985	2·560	
	10 "	8·500	1·970	5·120	1 : 2·60
Shorts (wheat).....	1 lb.	0·888	0·130	0·558	
	2 lbs.	1·776	0·260	1·116	
	3 "	2·664	0·390	1·674	
	4 "	3·552	0·520	2·232	
	5 "	4·440	0·650	2·790	
	10 "	8·880	1·300	5·580	1 : 4·30
Wheat.....	1 lb.	0·895	0·880	0·709	
	2 lbs.	1·790	1·760	1·418	
	3 "	2·685	2·640	2 127	
	4 "	3·580	3·520	2·836	
	5 "	4·475	4·400	3·545	
	10 "	8·950	8·800	7·090	1 : 8·00
Frozen wheat.....	1 lb.	0·852	0·135	0·696	
	2 lbs.	1·704	0·270	1·392	
	3 "	2·556	0·405	2·088	
	4 "	3·408	0·540	2·784	
	5 "	4·260	0·675	3·480	
	10 "	8·520	1·350	6·960	1 : 6·12

Hay.

Alfalfa hay..... ..	1 lb.	0·918	0·105	0·423	
	2 lbs.	1·836	0·210	0·846	
	3 "	2·754	0 315	1·269	
	4 "	3·672	0·420	1·692	
	5 "	4·590	0·525	2·115	
	10 "	9 180	1·050	4·230	1 : 4·00
Clover hay.....	1 lb.	0·847	0·710	0·419	
	2 lbs.	1·694	1·420	0·838	
	3 "	2·541	2·130	1·257	
	4 "	3·388	2·840	1·676	
	5 "	4·235	3·550	2·095	
	10 "	8·470	7·100	4·190	1 : 5·90

Hay.

Name of Feed.	Quantity.	Dry Matter.	Digestible Nutrients.		Nutritive Ratio.
			Proteins.	Carbohydrates. Fats x 2·25.	
Marsh hay or Salt Meadow hay	1 lb.	0·883	0·043	0·277	
	2 lbs.	1·766	0·086	0·554	
	3 "	2·649	0·129	0·831	
	4 "	3·532	0·172	1·108	
	5 "	4·415	0·215	1·385	
	10 "	8·830	0·430	2·770	1 : 6·4
Mixed grasses and clover	1 lb.	0·871	0·059	0·436	
	2 lbs.	1·742	0·118	0·872	
	3 "	2·613	0·177	1·308	
	4 "	3·484	0·236	1·744	
	5 "	4·355	0·295	2·180	
	10 "	8·710	0·590	4·360	1 : 7·4
Oat hay	1 lb.	0·860	0·047	0·406	
	2 lbs.	1·720	0·094	0·812	
	3 "	2·580	0·141	1·218	
	4 "	3·440	0·188	1·624	
	5 "	4·300	0·235	2·030	
	10 "	8·600	0·470	4·060	1 : 8·6
Peas and oats cured	1 lb.	0·895	0·076	0·450	
	2 lbs.	1·790	0·152	0·900	
	3 "	2·685	0·228	1·350	
	4 "	3·580	0·304	1·800	
	5 "	4·475	0·380	2·250	
	10 "	8·950	0·760	4·500	1 : 6·00
Timothy and clover	1 lb.	0·871	0·038	0·428	
	2 lbs.	1·742	0·076	0·856	
	3 "	2·613	0·114	1·284	
	4 "	3·484	0·152	1·712	
	5 "	4·355	0·190	2·140	
	10 "	8·710	0·380	4·280	1 : 11·3
Timothy hay (cut soon after bloom)	1 lb.	0·858	·025	0·426	
	2 lbs.	1·716	·050	0·852	
	3 "	2·574	·075	1·278	
	4 "	3·432	·100	1·704	
	5 "	4·290	·125	2·130	
	10 "	8·580	·250	4·260	1 : 19·0

Chaff and Straw.

Barley straw	1 lb.	0·858	0·009	0·415	
	2 lbs.	1·716	0·018	0·830	
	3 "	2·574	0 027	1·245	
	4 "	3·432	0·036	1·660	
	5 "	4·290	0 045	2 075	
	10 "	8·580	0·090	4·150	1 : 46·1

Chaff and Straw.

Name of Feed.	Quantity.	Dry Matter.	Digestible Nutrients.		Nutritive Ratio.
			Proteins.	Carbohydrates. Fats x 2·25	
Oat chaff	1 lb.	0·857	0·015	0·346	
	2 lbs.	1·714	0·030	0·692	
	3 "	2·571	0·045	1·038	
	4 "	3·428	0·060	1·384	
	5 "	4·285	0·075	1·730	
	10 "	8·570	0·150	3·460	1 : 23·06
Oat straw	1 lb.	0·909	0·013	0·413	
	2 lbs.	1·818	0·026	0·826	
	3 "	2·727	0·039	1·239	
	4 "	3·636	0·052	1·652	
	5 "	4·545	0·065	2·065	
	10 "	9·090	0·130	4·130	1 : 31·8
Wheat chaff	1 lb.	0·857	0·012	0·267	
	2 lbs.	1·714	0·024	0·534	
	3 "	2·571	0·036	0·801	
	4 "	3·428	0·048	1·068	
	5 "	4·285	0·060	1·335	
	10 "	8·570	0 120	2·670	1 : 22·2
Wheat straw	1 lb.	0·904	0·008	0·361	
	2 lbs.	1·808	0·016	0·722	
	3 "	2·712	0·024	1·083	
	4 "	3·616	0·032	1·444	
	5 "	4·520	0·040	1·805	
	10 "	9 040	0·080	3·610	1 : 45·1

Succulent Feeds.

Alfalfa	1 lb.	0·282	0·039	0·138	
	2 lbs.	0·564	0·078	0·276	
	3 "	0·846	0·117	0·414	
	4 "	1·128	0·156	0·552	
	5 "	1·410	0·195	0·690	
	10 "	2·820	0·390	1·380	
	20 "	5·640	0·780	2·760	
	30 "	8·460	1·170	4·140	
	40 "	11·280	1·560	5·520	
	50 "	14·100	1·950	6·900	1 : 3·53
Clover, red	1 lb.	0·292	0·029	0·152	
	2 lbs.	0·584	0·058	0·304	
	3 "	0·876	0·087	0·456	
	4 "	1·168	0·116	0 608	
	5 "	1·460	0·145	0·760	
	10 "	2·920	0·290	1·520	
	20 "	5·840	0·580	3·040	
	30 "	8·760	0·870	4·560	
	40 "	11·680	1·160	6·080	
	50 "	14·600	1·450	7·600	1 : 5·2

Succulent Feeds.

Name of Feed.	Quantity.	Dry Matter.	Digestible Nutrients.		Nutritive Ratio.
			Proteins.	Carbohydrates. Fats x 2·25.	
Corn ensilage.....	1 lb.	0·264	0·014	0 158	
	2 lbs.	0·528	0·028	0·316	
	3 "	0·792	0·042	0·474	
	4 "	1·056	0·056	0·632	
	5 "	1·320	0·070	0 790	
	10 "	2·640	0·140	1·580	
	20 "	5·280	0·280	3·160	
	30 "	7·920	0·420	4·740	
	40 "	10·560	0·560	6·320	
	50 "	13·200	0·700	7·900	1 : 11·3
Mangels	1 lb.	0 091	0·011	0·059	
	2 lbs.	0·182	0·022	0·118	
	3 "	0·273	0·033	0·177	
	4 "	0·364	0·044	0·236	
	5 "	0·455	0·055	0·295	
	10 "	0·910	0·110	0·590	
	20 "	1·820	0·220	1·180	
	30 "	2·730	0·330	1·770	
	40 "	3·640	0·440	2·360	
	50 "	4·550	0·550	2·950	1 : 5·4
Mixed pasture grass	1 lb.	0·250	0·023	0·157	
	2 lbs.	0·500	0·046	0·314	
	3 "	0·750	0·069	0·471	
	4 "	1·000	0 092	0·628	
	5 "	1·250	0·115	0·785	
	10 "	2·500	0·230	1·570	
	20 "	5·000	0·460	3·140	
	30 "	7·500	0·690	4·710	
	40 "	10·000	0·920	6·280	
	50 "	12·500	1·150	7·850	1 : 6·80
Oat Fodder (fed green)....	1 lb.	0·378	0·025	0·205	
	2 lbs.	0·756	0·050	0·410	
	3 "	1·134	0·075	0·615	
	4 "	1·512	0·100	0·820	
	5 "	1 890	0·125	1·025	
	10 "	3·780	0·250	2·050	
	20 "	7·560	0·500	4·100	
	30 "	11·340	0·750	6·150	
	40 "	15·120	1·000	8·200	
	50 "	18·900	1·250	10·250	1 : 8·20
Peas and Oats.....	1 lb.	0·203	0·018	0·111	
	2 lbs.	0·406	0·036	0·222	
	3 "	0·609	0·054	0·333	
	4 "	0·812	0·072	0 444	
	5 "	1·015	0·090	0·555	
	10 "	2·030	0·180	1·110	
	20 "	4·060	0·360	2·220	
	30 "	6·090	0·540	3·330	
	40 "	8·120	0·720	4·440	
	50 "	10·150	0·900	5·550	1 : 6·10

Succulent Feeds.

Name of Feed.	Quantity.	Dry Matter.	Digestible Nutrients.		Nutritive Ratio.
			Protein.	Carbohydrates. Fats x 2·25.	
Swedes or Rutabagas.....	1 lb.	0·114	0·010	0·086	
	2 lbs.	0·228	0·020	0·172	
	3 "	0·342	0·030	0·258	
	4 "	0·456	0·040	0·344	
	5 "	0·570	0·050	0·430	
	10 "	1·140	0.100	0·860	
	20 "	2·280	0·200	1·720	
	30 "	3·420	0·300	2·580	
	40 "	4·560	0·400	3·440	
	50 "	5·700	0·500	4·300	1 : 8·06
Milk.....	1 lb.	0·128	0 036	0·132	
	2 lbs.	0·256	0·072	0·264	
	3 "	0·384	0·108	0·396	
	4 "	0·512	0·144	0·528	
	5 "	0·640	0·180	0·660	
	10 "	1·280	0·360	1·320	1 : 3·07
Skim Milk.....	1 lb.	0·094	0·029	0·059	
	2 lbs.	0·188	0·058	0·118	
	3 "	0·282	0·087	0·177	
	4 "	0·376	0·116	0·236	
	5 "	0·470	0·145	0·295	
	10 "	0·940	0·290	0·590	
	20 "	1·880	0·580	1·180	1 : 2·00

PART VI.

THE HOSPITAL.

The following notes on a few of the more common troubles likely to demand the attention of every man having to do with dairy cattle, make no claim to originality. All that can be said is that the suggestions offered or the treatments outlined have been tried by the writer personally and found to be satisfactory and, in most cases, efficacious.

STABLE HYGIENE.

In dairy stable management, the great aim should be the preventing rather than the curing, of disease. In spite of the greatest precautions, however, no stable is likely to be always free from some one or more of the numerous troubles which seem to be ever ready to intrude where the least opening offers through carelessness of some kind, or laxity in the enforcement of the most strict rules of hygiene, and of quarantine or separation from other herds, possibly infected.

Some preventive measures that can be fairly readily put into force might be briefly stated as follows:—

(1). Keep the stable free from dust and dirt of all kinds, that is, observe perfect cleanliness in everything having to do with the cow and the stable.

(2). Supply an abundance of good, pure air, so introduced as to avoid draughts or air currents striking any individual.

(3). Admit an abundance of sunlight through clean windows.

(4). Periodically disinfect the stables with some powerful disinfectant or germ-destroyer, as corrosive sublimate.

(5). Give a liberal but judicious supply of good food and clean water, and

(6). Test for tuberculosis at least once each year.

THE MEDICINE CHEST.

Every dairyman should keep a few simple remedies and appliances on hand. A small cupboard or a chest should be kept for

this purpose exclusively. It should be located in a dry spot and should never be left unlocked. The owner and one or two other trusted men, if the staff is large, should have keys. Every drug should be carefully and clearly labelled and the dose indicated on the label. To start out, a good medicine chest should contain the following:—

Quantity.	Drugs.	Purpose.	Dose for Adult.	Dose for Calf 6 mos. or under.
10 lbs.	Epsom salts	Purgative, indigestion	1 to 1¼ lbs	4 ozs.
1 lb	Ginger	Tonic, diarrhoea, indigestion	2 oz.	1 oz.
1 "	Baking soda	Indigestion, colic	2 "	
1 gal	Linseed oil, raw	Laxative, purgative, colic	1 to 2 pints	¼ pint.
½ pint	Olive oil	Soothing for external use, udder		
½ lb	Saltpetre	Urinary troubles	1 to 1½ ozs.	
½ "	Sulphate of iron	Tonic	½ to 1 dram	¼ dram.
½ "	Gentian root	"	4 drams	1 "
½ "	Boric acid	Injections into udder	20 grs. to 1 oz. water	
1 pint	Turpentine	Colic, bloating	½ cup, 2 to 3 ozs.	
½ lb	Fluid extract belladonna	Fever, cramp, colic	1 dram fluid.	
1 gal	Zenoleum or creolin	For external use	5 to 100 water	
1 lb.	Carbolic acid, *Poison*	"	1 " 30 "	
1 oz.	Corrosive sublimate, *Poison*	"	1 " 1000 "	

1 tablespoonful is equal to about ½ oz.
1 dessertspoonful equals about 2 fluid drams.
1 teaspoonful equals about 1 fluid dram.

Besides the above drugs, a few appliances should be included, chief among which might be named:—

Bottle for drenching, (long necked bottle), trocar and canula, probang, graduated beaker 4 oz., clinical thermometer, five or six feet of ½ or ¾-inch hose, funnel (glass), milk fever apparatus, small scale, hard rubber syringe, teat tubes and bistoury. Where serious trouble occurs, it will be found advisable to consult a good veterinarian, if such a practitioner be within reach. To supplement these notes, a good veterinary manual might be added to the farmer's library. 'Veterinary Elements,' by A. G. Hopkins, D.V.M., V.S., B. Agr., is about the only book of this description published in Canada and is a valuable work.

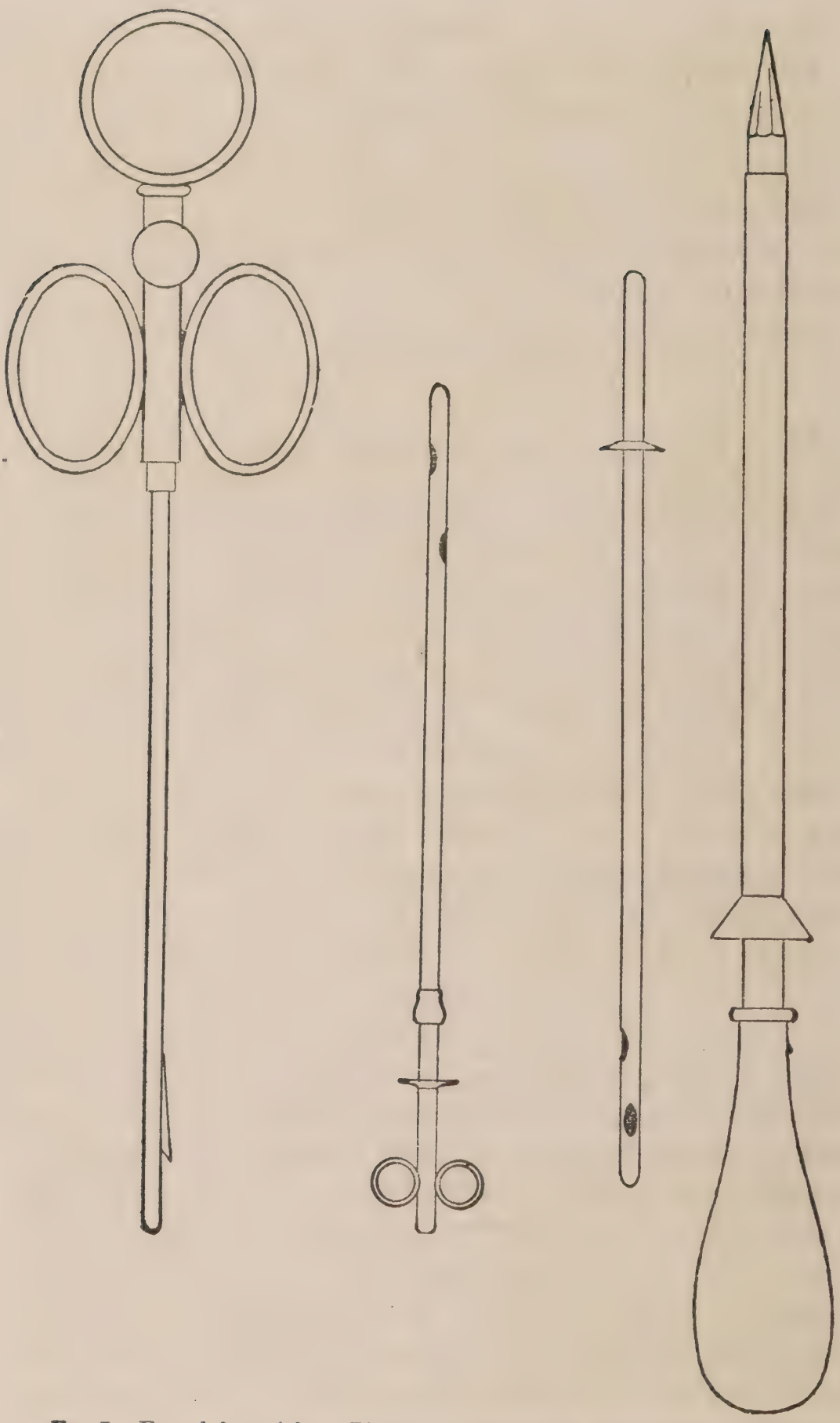

Fig. 7.—From left to right:—Bistoury, self-retaining milk tube, common milk tube, trocar and canula.

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Drenching a Cow.

NOTES ON SOME DISEASES.

Abortion.—Of all diseases or troubles to afflict the dairyman abortion is undoubtedly the most to be feared. The loss of the fœtus, or abortion, is sometimes due to a blow, a prod from another cow, or some other more or less severe injury. The more common cause is, however, the presence of a germ disease in the womb. Abortion, when due to this disease, is contagious and difficult of cure or eradication.

Contagious Abortion is, undoubtedly, a curable disease; it is, however, at the same time most difficult to control and almost impossible to completely eradicate, once it gets into a district or neighbourhood. Preventive or precautionary measures can scarcely be too stringent. The observance of strict quarantine against animals of any age or either sex from infected herds is absolutely necessary.

If, however, in spite of all efforts at prevention, the disease should get a foothold, no time should be lost in the inception of most energetic and thorough measures of control and eradication. The first animal to be affected in a herd usually drops a dead calf or fœtus. The fact of the cow aborting from no apparent cause and giving birth to a dead fœtus, should excite suspicion and lead to immediate precautionary action. The things to do are:—

(1). *Isolate* the cow or cows, burn the fœtus and afterbirth, etc., also all litter soiled with the fluids escaping at time of birth. Clean out the whole barn and burn the refuse. Whitewash the walls, floors. stall divisions, etc., with a solution of corrosive sublimate, one ounce in 8 gallons of lime wash ready for application. Apply freely.

(2). *Wash off* the tail and all adjacent parts of all animals in the stable with a solution of carbolic acid, 5 per cent, or a solution of creolin, zenoleum or phenol, about three per cent, in water. The uterus should be irrigated with a similar solution, kept well mixed. A funnel and a bit of hose 5 or 6 feet long will prove satisfactory as apparatus for this operation. The washing and irrigating treatment had better be repeated every second day for ten days or a fortnight.

(3). *The isolated or aborted animals* should be washed and irrigated every day for two or three weeks and then every other day

for a considerably longer period, until all signs of a discharge disappear.

(4). *The stable* used for the isolated animals should be kept thoroughly disinfected, care being taken to spray with a solution of corrosive sublimate in water, 2 per cent solution, every day or two, the floor and partitions until all discharge stops.

(5). *Do not breed affected cattle* until absolutely certain that all danger of infection has disappeared.

(6). *The bull* should be disinfected by washing the under part of the body with the corrosive sublimate solution and by the injection of one of the other disinfecting solutions mentioned, in considerable quantities, into the sheath, both before and after service.

(7). *Attendants* should not be the same for the isolated animals as for the unaffected herd and they should not be allowed to associate with the attendants of, nor visit healthy herds not under their care

Bloat or hoven will occur occasionally in almost any herd. A too liberal supply of some succulent food, as wet, green clover, or green corn, is usually the cause. Practically the only treatment, or at least the first treatment in severe cases, is to tap with trocar and canula on the left side, between the last rib and the point of the hip. Then give a drench of about 2 oz. of turpentine in 1½ pints raw linseed oil. Drench slowly and carefully.

Bloody milk may be due to a variety of causes, as mammitis, external udder wounds or bruises and internal udder injuries. Frequent milking and hot fomentations are the best treatment, keeping in mind always the removal of the cause, if at all possible.

Chapped teats often occur in the spring or in wet, cold weather. They may be helped by applying oxide of zinc ointment or carbolic salve.

Dehorning dairy cows is becoming more common and is, under most conditions, quite the best practice. A good plan is to dehorn as calves. This can be done by burning the horn buttons with caustic potash or concentrated lye, when the calves are about ten days old. In the case of potash being used, the method is to clip the hair from around the buttons, moisten slightly, and rub the potash on. Care should be taken to keep the potash from coming into contact with the hands. Sufficient moisture should be used to

ensure a moderate amount of potash remaining on the button, but not enough to cause the potash and water to run down and so endanger the eye or remove the hair.

If the animal is not dehorned when a calf, it should be dehorned when about two and a half years old. This may be done with a saw or a clipper. The Keystone clipper is probably the best instrument wherewith to perform the operation. When clipping, it is best to cut so close to the head as to remove a ring of about one-eighth of an inch of hair with the horn. By clipping at that point, the operation can be performed much more quickly, with less pain to the animal and with less risk of any unpleasant after-effects. Searing the horn stub with a hot iron immediately after clipping is a good practice, but is probably unnecessary under most conditions. The best months to dehorn in are October, November or April.

EVERSION OF THE UTERUS, INVERSION OF THE WOMB, OR CASTING OF THE WITHERS. Are all three different ways of describing the same condition, in which the uterus or womb is thrust out and hangs down from the vagina in a large mass. It occurs usually immediately after calving, but may happen, in some degree at least, at almost any time, even when cows are pregnant.

The protruding mass should be carefully washed with cold water containing a small percentage of zenoleum, creolin or carbolic acid. When clean, it should be gently but firmly shoved back into place. This may be done by placing the closed fist under the mass and pressing it steadily upward and inward into position, in spite of straining on the part of the cow. When in place, it should be held by stitching the lips of the vulva and leaving thus for a day or even longer. Tying a small rope tightly round the body just behind the fore legs and another similar rope just in front of the hind legs will do much to keep the cow from straining. Building up a platform 6 or 7 inches high, in such a way as to raise the hind quarters higher than the front, will help correct any tendency toward this condition and will also help cure any difficult case. Cows that have once suffered from eversion of the uterus are very likely to be similarly affected each time they calve.

FLIES cause great loss to the dairy farmer by so irritating the cows as to reduce the flow of milk very materially. They may be combatted by the more or less frequent application of suitable

repellents to those parts of the body commonly attacked. Many so-called fly-repellents on sale, fail to effectually repel the flies for any considerable length of time. A repellent that has been found effective here and that is moderately cheap, comparatively long-lasting in its effects and only slightly objectionable, is a mixture of unsalted lard 10 lbs., pine tar 1 lb., carbolic acid 1 oz., thoroughly mixed and applied every few days as required on those parts where flies most commonly settle.

Where cattle are milked in stables during the summer months, it is usually found quite impossible to keep the byre from becoming filthy with flies.

The setting around, in shallow pans, of a mixture of sweet skim milk two parts and formalin one part, will do much to reduce the pest. This plan has been tried here and found very effective in clearing the flies from the cow barn and the piggery.

LICE usually make their appearance known by rendering the animal affected unthrifty and causing more or less hair to fall off or be scratched or rubbed off on account of the extreme itchiness induced. The washing of the animal with a strong solution of such substances as Creolin, Zenoleum or liquid sheep dips, about five per cent solutions (1 to 20) being employed, is one remedy; another plan is to clip the hair short, beginning about six inches down on the tail and extending in a strip about four inches on each side of the backbone and up the neck to the poll. Along this strip, apply freely some heavy oil such as fish oil. This is usually an effective but not a very pleasant method of combatting the evil.

LUMPY JAW occurs occasionally. It shows itself by a hard swelling or growth on the lower jaw. This grows fairly rapidly as a rule and finally bursts. If the animal is not very valuable, it is well to slaughter and use for meat before the lump develops to any great size or breaks. If a valuable animal, it would probably be worth while trying to cure the disease. The treatment is to give iodide of potash in doses of 1 to 3 drams once daily, dissolved in a half-pint of water. Continue this for from six to eight days, or until the discharge of mucus from eyes and nose indicates a sufficiency, for the time at least. If the swelling does not disappear, the treatment should be repeated in a couple of weeks.

MAMMITIS, GARGET, CAKED BAG OR INFLAMMATION OF THE UDDER, as variously known, shows itself by a swelling of the udder in one or more quarters, sometimes extending up along the belly. In mild cases, the cow should be blanketed, a dose of Epsom salts and ginger administered and the affected quarter or quarters rubbed gently with sweet oil or unsalted lard. Bathing continuously with hot water for from half an hour to an hour will help matters. In any case, handle very gently, protect from draughts, make the animal comfortable, give a light dose of a laxative medicine and feed a light ration for a few days. If a very severe case, it is sometimes necessary to poultice with a hot poultice for a few hours.

A contagious form of this disease exists. Where this form is suspected, every precaution should be taken to disinfect the udder externally by washing, and internally by injecting a solution (2 per cent) of carbolic acid. The injected material should be milked out a few minutes after injection.

PARTURIENT APOPLEXY OR MILK FEVER is a disease peculiar to heavy-milking cows. It occurs usually within two or three days after calving. It may generally be avoided by feeding lightly for a few days before and after calving, and by leaving the calf with the cow for a couple of days, at the same time being careful not to draw off all the milk from the udder at any given time, until the cow is nearly, or quite, normal again after sickness or weakness due to parturition has passed.

The disease, as a rule, comes on suddenly, the animal being found down and partly unconscious without any previous symptoms, although, occasionally, uneasiness, dullness, falling-off in milk and loss of appetite precede the final apoplectic condition.

When observed in this latter stage, she should be straightened up to rest on her brisket. Then, if able to swallow, a dose of Epsom salts may be administered. If the cow will not drink water, then the salts or other medicine should be administered through a probang, and if no probang is available it is much better to give no medicine.

The Schmidt treatment should be given as soon as it is possible to get things ready. If no special apparatus is kept for this purpose, a common syringe or a bicycle pump with special nozzle attachment may be used. Disinfect or sterilize the syringe or pump, particularly the nozzle or tube which must be inserted into the teat. Insert in

the pump or syringe, cotton batting, in such a way as to ensure all air coming out of the nozzle having to traverse the cotton in coming out and pump air through the same a few times to be sure it is

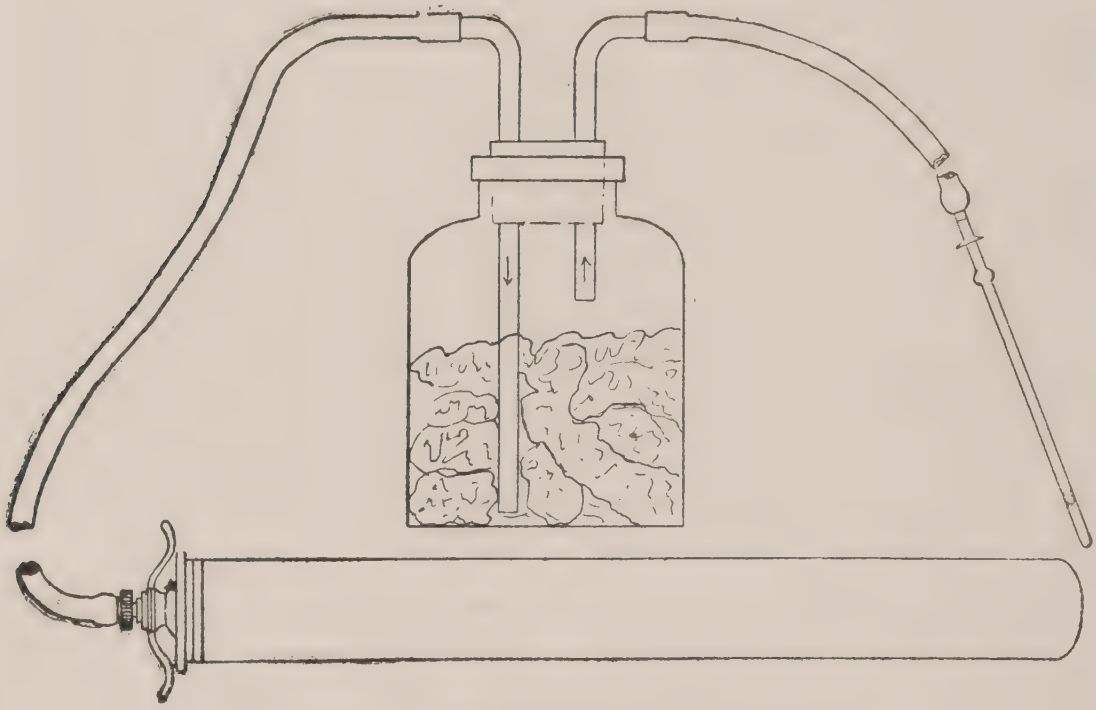


FIG. 8.—A home-made Milk Fever Apparatus.

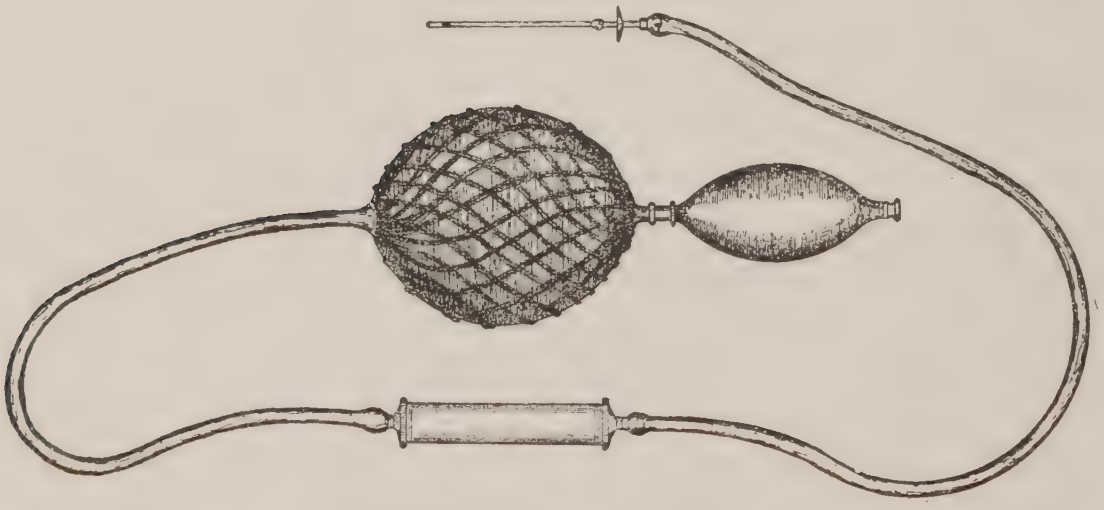


FIG. 9.—Milk Fever Apparatus.

working satisfactorily. Wash the udder and teats carefully, if udder is much distended, draw off part of milk from udder, then, inserting the nozzle into the teats in turn, pump air into the four quarters, tying teats with tape to prevent escape. One injection will probably

be sufficient. If recovery is slow, repeat the injection. Feed lightly for a few days, on laxative food, and a recovery is practically ensured.

PNEUMONIA OR INFLAMMATION OF THE LUNGS is a disease of quite frequent occurrence among dairy cattle. It occurs most commonly in cold weather, but may attack the animal at any season. It is usually due to exposure to draughts when the animal is warm.

The first symptoms are, as a rule, chills followed by fever, the temperature rising not infrequently to 104 or even 106 degrees Fahrenheit. The animal has a hang-dog air and, on putting the ear to the chest over the lungs, a crackling sound can usually be heard, though in some severe cases, no sound can be heard at all.

Blanket the animal; put into a dry, bright box stall, where the ventilation is good; keep well bedded and feed light rations of easily-digested food, as bran mash, roots, and a small amount of clover hay, if the animal will take it.

Give kind treatment, a dose of raw linseed oil, and if very weak, light doses of stimulant, as two oz. of alcohol, (whiskey), or spirits of nitrous ether 1 oz., every three or four hours. A mustard blister over the lung will sometimes give relief. It should be left on for several hours. The best method in applying it is to make into a paste with warm water and rub into the hair, then put a cloth over the treated part and blanket.

Where this disease is suspected, a veterinarian should be called in, if at all possible, as it is difficult to treat, and yet, if the case is well handled, recovery is quite to be expected.

RETENTION OF AFTERBIRTH occurs occasionally in almost every herd. It is probably due to some pecularity in the physical condition of the animal, but no one seems to have been able to determine why this rather unpleasant and expensive condition should occur in one case,and another cow, similar in every way and fed on similar feeds, should be normal in this respect, that is, discharge the afterbirth very soon after parturition.

When retention occurs, it is usually well to let it hang for a day, then, if not coming away spontaneously, proceed to remove it.

To do this, the operator should remove the shirt, carefully wash the arms to the shoulder and smear them with clean carbolized oil

or lard; insert the hand and follow the placenta till a point of attachment is reached. With the thumb and first and second finger, gently but firmly separate the placenta from the button or cotyledon on the womb and proceed to the next point of attachment. The uterus should be thoroughly flushed with a disinfectant after removal of the placenta, using carbolic acid one part to fifty parts of water, or zenoleum or creolin in the same proportions.

RINGWORM.—This disease, sometimes called 'barn itch,' occurs more commonly on calves than on older animals. It shows itself in circular patches from half an inch to several inches in diameter, from which the hair has fallen and which present a scurfy or scaly appearance. This condition is due to the presence of a fungus.

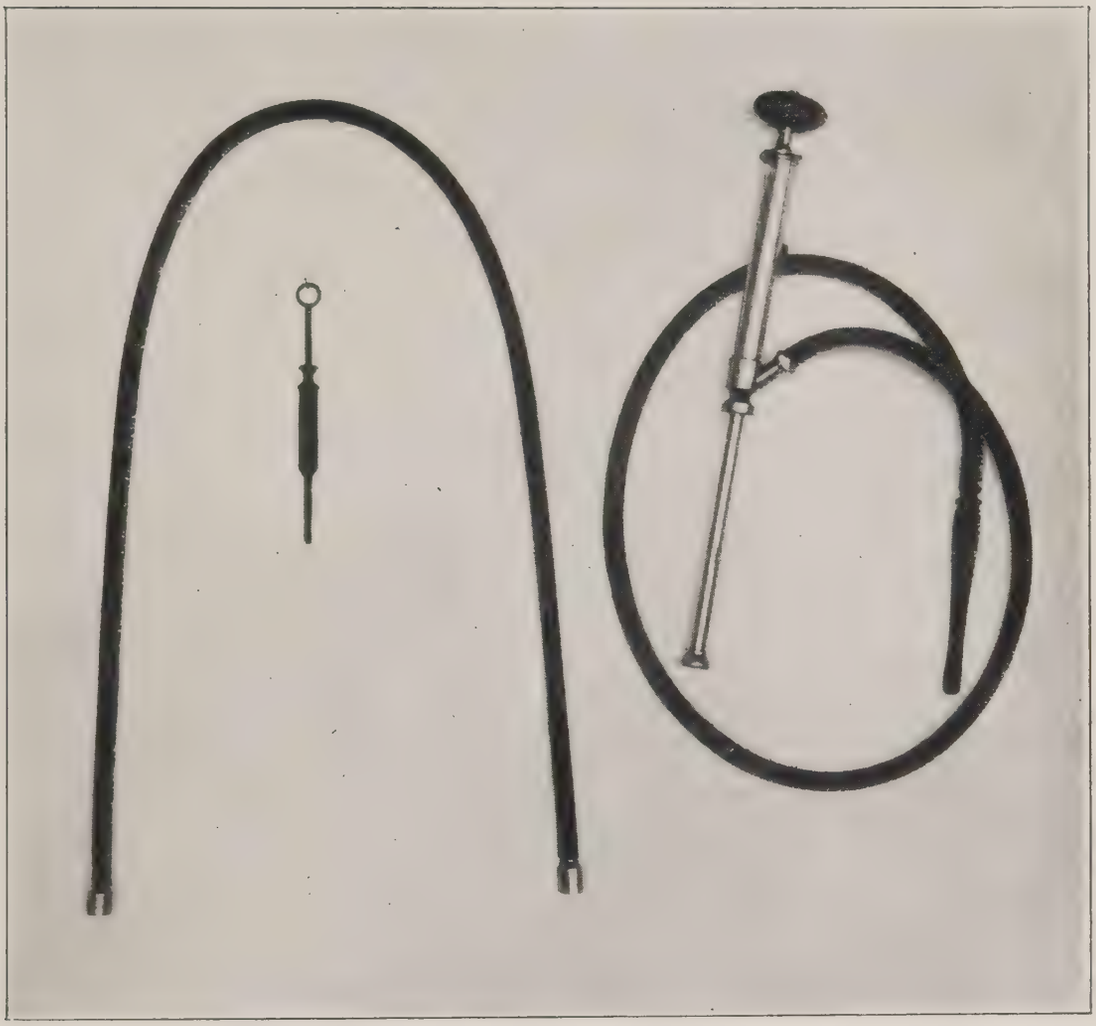
It may be cured by painting with iodine several days in succession or by applying fresh for a few times a mixture of one ounce sulphur ointment and one dram iodine crystals.

SCOURING IN CALVES is usually due to bad feeding. Following the methods of feeding calves outlined elsewhere in this bulletin, will almost certainly prevent the occurrence of this trouble and will usually cure it, if already in the stable.

Occasionally, however, what is known as White Scour occurs, when vigorous measures must be taken to right matters. The first consideration must be the removal of the cause, which may usually be done by administering a dose of some good laxative, say 2 oz. of castor oil, or somewhat less in the case of a very young calf. Then feed lightly and frequently on easily-digested food, as warm, sweet milk, with a small amount of ground flax therein. Cleanliness and uniformity in quality, quantity and hours of feeding are the great preventatives and likewise the best curative agents.

TUBERCULOSIS is one of the most difficult of diseases to handle. The tuberculin test is practically the only way to diagnose this disease, except in most advanced or what are known as clinical cases. In such cases, however, the tuberculin test not infrequently fails to give the typical reaction or rise in temperature. If tuberculosis is suspected, the cattle should be tuberculin tested and any 'reacters' as well as clinical cases, removed from the herd. There is no known remedy.

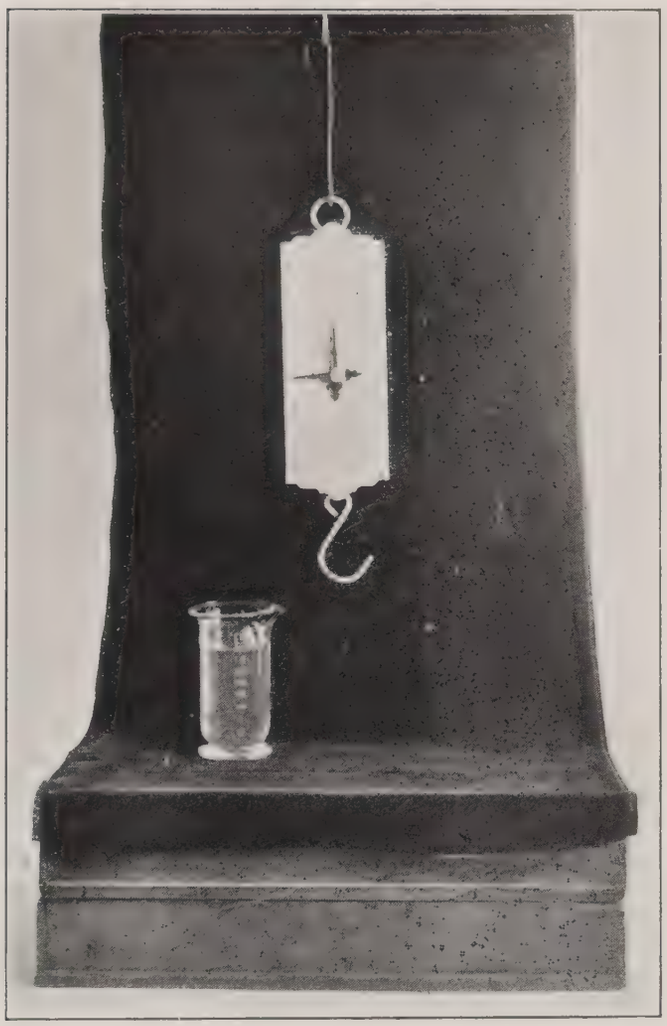
WARBLES or the small lumps on the backs of cattle, are due to the grubs developed from the eggs of a species of bot fly. The grubs



Injection Pump. Syringe.

Probang.

PLATE XXX.



Dial-faced scale. When empty pail is suspended the pointer, presently horizontal, should be vertical. Measuring glass—a very necessary article around a dairy barn.

should be forcibly expelled from these lumps and destroyed, or the tops of the lumps covered with turpentine which will usually kill the grubs and permit of their being absorbed.

WOUNDS should be looked after as soon as observed. They should be carefully washed out and treated with a weak solution of carbolic acid or creolin. Keep the wounds clean, but do not irritate.

PART VII.—EXPERIMENTS WITH DAIRY CATTLE.

LINES OF EXPERIMENTATION.

At the Central Experimental Farm at Ottawa several lines of experiments with dairy cattle have been conducted during the past twenty years, the chief being:—

(1) Experiment to determine the number of dairy cattle that might be carried to the acre of arable land on the average Canadian farm.

(2) Breeding.

(3) Influence of hours of milking on quantity and quality of milk.

(4) Cost of feeding and economy of production of milk. Experiments with various feeds, both roughage and concentrates, to determine their values as feeds for dairy cows. Feeding methods.

(5) Ventilation.

(6) Individual records.

SUMMARY OF THE WORK DONE ON A FORTY-ACRE LOT AT THE CENTRAL EXPERIMENTAL FARM, 1891-1894.

Dr. J. W. Robertson in 1891, while he was Agriculturist at the Central Experimental Farm, began experiments on a forty-acre lot with the object of 'directing the attention of farmers to the practicability of keeping cattle in larger numbers than had been their custom on the moderate and small-sized farms of Canada' and in order to illustrate how many cattle might be fed each year on the products of that area.

The work was continued for five years, from 1891 to 1894 inclusive, but the experiment was broken in the period 1893-1894, many animals having to be slaughtered then on account of their being affected with tuberculosis.

Thirty cows were kept on the lot, but, with this number, quantities of other feeds had yearly to be transferred from the general farm, and this feed being considered according to its value, the number of cows which is was found possible to feed on the produce of the forty-acre lot exclusively was as follows:—

1891-1892	14 cows.
1892-1893	23 "
1893-1894	broken period.
1894-1895	25 cows.
1895-1896	24 "

After the beginning of the experiment, no manure other than that produced by the animals on the forty acres was applied to the land.

In many cases, two crops a year were taken off some portions of the land, and in some seasons the total amount of pasturage was increased by allowing the cows to feed on the aftermath of a crop, the area of which is given under some other head, and thus the total area as cropped is in no case exactly 40 acres.

Following are the different crops raised on the lot during the period this experiment was carried on. The areas allotted to each are given, together with the weight of crop obtained where it was possible to determine this. Furthermore, the total cost of growing the crops is stated. This included rent of land at $3 per acre, the labour for cultivation, seed, sowing, harvesting and delivering them at the barn, root house, silos or stable, threshed or cut and ready to feed. It also included an allowance for a proportion of the time of the farm foreman, but it did not include any allowance for the use of farm machinery (except the engine), nor did it include any amount as an equivalent for the exhaustion of the soil or the application of manure. The time of a man was reckoned at $1.25 per day, and the time of a man and a team of horses at $2.50 per day.

CROPS ON 40 ACRE LOT 1891.

Variety.	Yield in		Estimated Value per ton.	Total Value.
	Tons.	Lbs.	$ cts.	$ cts.
14 acres mixed grain crop.. Straw	21	1,791	4 00	87 58
14 acres mixed grain crop.. Grain	11	365	20 00	223 65
3 acres roots	37	131	4 00	148 26
½ acre cabbage	7	1,296	2 00	15 30
2 acres spring rye put into silo	7	1,905	2 00	15 91
11½ acres corn, cut for ensilage	130	1,750	2 00	261 75
1 acre corn, cured in stooks	5	1,940	4 00	23 88
			Per acre.	
1⅓ acres corn, cut and fed green			21 00	31 50
3⅜ acres mixed grain, fed green			17 50	64 17
Total				872 00

The cost of producing these crops was $565.74 which is $14.14 per acre.

CROPS ON 40 ACRE LOT 1892.

Variety.	Yield in		Estimated Value per ton.	Total Value.
	Tons.	Lbs.	$ cts.	$ cts.
$8\frac{75}{100}$ acres mixed grain crop.. Straw	12	1,039	4 00	50 07
$8\frac{75}{100}$ acres mixed grain crop.. Grain	6	1,317	20 00	133 17
5 acres mixed grain crop, cured	16	605	4 00	65 21
$6\frac{90}{100}$ acres mixed grain crop and rye, fed green	34	906	2 00	68 90
5 acres roots	64	448	4 00	256 89
$16\frac{33}{100}$ acres corn with horse beans and sunflowers, cut for ensilage	245	1,467	2 50	614 33
$2\frac{43}{100}$ acres pasture				
Total				1,188 57

The total cost of producing these crops was $795 or $19.87 per acre.

CROPS ON 40 ACRE LOT 1893.

Variety.	Yield in		Estimated Value per ton.	Total Value.
	Tons.	Lbs.	$ cts.	$ cts.
$8\frac{21}{100}$ acres mixed grain crop.. Straw	15	863	4 00	61 72
Grain	4	1,973	20 00	99 73
$6\frac{66}{100}$ " " and rye cut and cured as hay	19	155	8 00	152 62
4 acres roots	88	450	4 00	352 90
22 acres corn with horse beans and sunflower heads made into ensilage	217	461	2 50	543 08
$2\frac{43}{100}$ acres pasture				
Total				1,210 05

The total cost of producing these crops was $833 or $20.82 per acre.

CROPS ON 40 ACRE LOT 1894.

Variety.	Yield in		Estimated Value per ton.	Total Value.
	Tons.	Lbs.	$ cts.	$ cts.
$7\frac{75}{100}$ acres mixed grain crop cured	18	200	4 00	72 40
1 " " cut green.	7	1,390	1 75	13 46
4 acres roots	100	907	4 00	401 82
$28\frac{6}{100}$ acres corn, beans and sunflower heads made into ensilage	289	850	2 50	723 56
$4\frac{57}{100}$ pasture				
Total				1,211 24

The total cost of producing these crops was $816.54 or $20.41 per acre.

CROPS ON 40 ACRE LOT 1895.

Variety.	Yield in		Estimated Value per ton.	Total Value.
	Tons.	Lbs.	$ cts.	$ cts.
$2\frac{35}{100}$ acres sunflower heads	16	791	6 30	103 29
2 acres carrots	46	1,160	4 60	186 32
2 acres mangels	47	1,750	4 00	191 50
$12\frac{75}{100}$ acres corn cut for ensilage	165	1,028	2 00	331 02
5 acres corn and horse beans cut for ensilage	74	1,769	2 50	187 21
$4\frac{25}{100}$ acres horse beans cut for ensilage	30	815	2 70	82 10
10 acres mixed grain crop cured	26	1,675	4 00	107 35
4 acres mixed grain 2nd crop cut green	6	710	1 75	11 13
1 acre corn fodder	7	1,345	4 00	30 69
Total				1,230 61

BREEDING.

The work of breeding for milk production shows that (*a*) superior dairy cows may be found in all breeds; (*b*) pure-bred females are not essential to success in dairy farming, but a pure-bred bull should always be used.

REGULARITY OR IRREGULARITY OF HOURS OF MILKING.

A series of experiments was carried on in 1900-01-02 to gain information as to the effect of milking cows at unequal intervals upon the quantity and quality of the milk produced. The following statement summarizes the results:—

—	Average daily yield of milk.	Average per cent per cow per day.	Average weight of fat per cow daily.
Irregular	26·7	3·96	0·9937
Regular	25·06	4·23	1·0112

The results show that where the irregularities are slight, the quantity and quality are not materially affected. Where the irregularities are considerable there are some changes. After the shorter

interval, the quantity of milk is decreased, but the fat content is increased. Conversely, after the longer interval the quantity is increased, but the fat content decreased.

EXPERIMENTS IN ECONOMY OF PRODUCTION OF MILK AND COST OF FEEDING.

These two lines of work are so bound up with one another that it is impossible to properly deal with one without dealing with the other.

In these experiments the following matters were taken into consideration and careful records kept with relation thereto:—

1. Quality and quantity of milk produced during period of lactation.
2. Length of lactation period.
3. Value of products at current market prices.
4. Amounts of feed (roughage and concentrates) consumed.
5. Total cost of feeding.
6. Profit per cow.

The cost of the feeding stuffs was always fixed according to the price of the articles on the market in the case of purchasable feeds; in the case of ensilage and roots, $2 a ton was allowed, this being the usual charge for such feeds in experimental work in Canada and the United States.

FINDINGS.

Summarizing the experiments along the above lines, it may be said that our work would seem to show:—

That cheap milk production is assured by the choice of succulent or juicy foods, such as mangels, sugar beets and ensilage, and nitrogenous or flesh and milk-forming foods such as clover and alfalfa hay, bran, oats and oil meal.

That best returns come from well bred stock in well-lighted, well-ventilated and comfortably bedded stables.

That the cost of feeding should be carefully studied, as the experience gained at the Central Experimental Farm shows that savings or improvements are frequently possible, individuals being often fed too heavy or too light a ration for the milk being produced in a given time.

Careful records have been kept since 1899 of the different amounts of different feeds fed to each cow. From time to time, the ratio of each in the feed has been changed to meet the needs of various animals, but the ration which after twelve years' trial seems to give the best results appears to be about as follows :—

		Lbs.
Roughage:	Corn ensilage	40
	Roots	20
	Cut oat straw	6
	Hay	6

Meal:—For every four pounds of milk one pound of a mixture made up about as follows:—

	Lbs.
Bran	600
Shorts	200
Gluten meal	300
Oil cake meal	200

Closely allied to this record of feeding are the records which have been kept of the milk of each cow for the past twelve years. Not only is the weight of milk kept but also the record of its butter-fat content, hence, by allowing the current prices for butter fat and skim milk and taking into account the cost of feeding, the net annual profit or loss of each cow may be found.

The following are the average returns per cow for the years since 1899:—

Year.	No. cows kept.	Average return per cow.
		$ cts.
1899 ending June 30 of that year	25	51 22
1900 " "	20	64 18
1901 " "	18	69 93
1902 " "	26	73 50
1903 " "	38	63 60
1904 " "	28	75 63
1905 " "	35	65 62
1906 (9 months, July 1, 1905, to March 31, 1906)	40	41 92
1907 ending March 31 of that year	50	52 60
1908 " "	38	73 71
1909 " "	49	69 43
1910 " "	65	76 78
1911 " "	54	80 27

General view interior Main Cow Barn, Ottawa.
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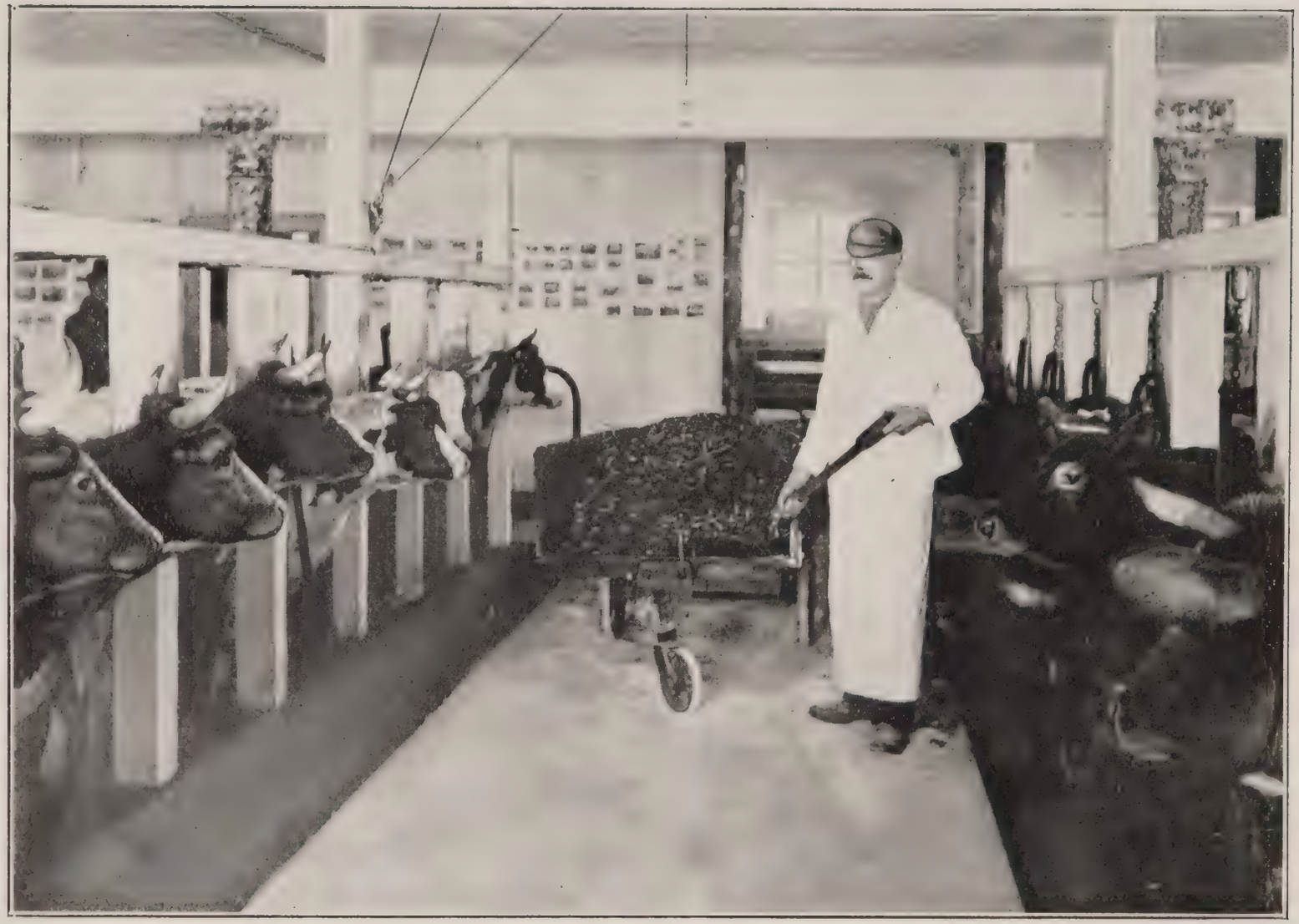


Feeding Time. Main Cow Barn, Ottawa.

SOME FEEDING EXPERIMENTS.

'DRY VS. WET FEED.'

Two lots of cows of three each were fed for seven days on similar rations. On the eighth day the rations were changed, lot 1 being given a meal ration of barley, oats and oil meal dry, and lot 2 a meal ration of bran and gluten meal wet. The same amounts of ensilage and hay as had been fed the first seven days were supplied all through the experiment. After 14 days on this feed, the rations were interchanged between the lots of cows.

The following is a summary of the results:—

Feed.	Average milk per day.	Average per cent fat.	Average yield b. f.
Ensilage, clover hay, bran and gluten (fed wet)	114	3·83	4·365
Ensilage, clover hay, barley, oats and oil meal (fed dry)	116½	3·39	4·927
Difference in favor dry feed	2½	0·16	0·262

It will be seen from this table that not only is there an increase in quantity of milk, but also an increase in the quantity of fat, when cows were fed on dry feed, as compared with the same cows fed on wet feed.

ENSILAGE VS. MANGELS.

Two groups of cows (C and D) were put in this experiment. For the first two weeks they were fed the regular ration, at the end of which time the 'C' group was put on to 'Ensilage, Hay and Meal' while the 'D' group was fed 'Mangels, Hay and Meal.' At the end of two more weeks on these respective rations, the 'C' group was fed 'Mangels, Hay and Meal' and the 'D' group 'Ensilage, Hay and Meal.'

The following is a short summary of the results:—

		Summaries.	
		Summary.	Summary.
		Mangels, Hay, Meal.	Ensilage, Hay, Meal.
Average weight to start	Lbs.	983	982
" at end of 2 weeks	"	1,006	1,006
Loss—or gain +	"	+ 23	+ 24
Meal fed group in 1 day	"	29¼	29½
Hay fed group in 1 day	"	20	20
Ensilage fed group in 1 day	"	271	200
Meal fed in 2 weeks	"	409	413
Hay fed in 2 weeks	"	280	280
Mangels in 2 weeks	"	3,795	.....
Ensilage in 2 weeks	"	.....	2,800
Value of food fed group in 2 weeks	$	8 87	7 91
" 1 cow in 1 day	Cts.	15·4	14·2
Milk produced by group in 2 weeks	Lbs.	1,007	1,003
First day's milk from group	"	75	71
Second day's milk from group	"	75	73
Average daily yield of group during 1st week	"	73	73
" " 2nd "	"	71	70½
" " 2 weeks	"	72	71½
Next to last day's milk from group	"	73	68½
Last day's milk from group	"	73	71½
Decrease in rate of daily milk yield in 2 weeks	"	4½	6½
Per cent decrease in rate of daily milk yield	p.c.	5½	8

The results show that mangels are practically no better than ensilage for milk production. The cost of growing them is, however, appreciably higher than the cost of growing corn, which fact raises the daily cost of the cow's food when mangels are used to 15·4 cents as compared to 14·2 cents when corn ensilage is fed, a difference of 1·2 cents per day.

DRY FORAGE VS. SUCCULENT FORAGE.

The dry forage used in this experiment was hay, while roots and ensilage made the succulent forage.

27889—10½

	Method of Feeding.							
	1st period of 2 weeks.		2nd period of 2 weeks.		3rd period of 2 weeks.		Summaries.	
	Group E.	Group F.	Group E.	Group F.	Group E.	Group F.		
	Number in group, 4.	Number in group, 4.	Number in group, 4.	Number in group, 4.	Number in group, 4.	Number in group, 4.	Summary.	Summary.
	Roots and Ensilage, Meal, Hay.	Roots and Ensilage, Hay, Meal.	Dry Feed.	Succulent Feed.	Succulent Feed.	Dry Feed.	Dry Feed.	Succulent Feed.
Average weight to start ..... Lbs.	....	.....	994	972	1,007	1,049	1,022	988
" at end of 2 weeks ..... "	.....	.....	1,007	1,004	1,049	1,016	1,011	1,027
Loss − or gain, + ... "	.....	....	+ 13	+ 32	+ 42	−33	−11	+ 39
Meal fed group in 1 day ..... "	30	29	31	30½	29	30	30½	29¾
Hay " ..... "	12	12	82	20	20	80	81	20
Ensilage and roots fed group in 1 day ..... "	200	190	.....	252	242	....	....	247
Meal fed in 2 weeks ..... "	420	406	434	427	406	420	427	416
Hay " ..... "	168	168	1,150	280	280	1,120	1,135	280
Ensilage and roots fed in 2 weeks ..... "	2,800	2,660	.....	3,530	3,388	.....	.....	3,459
Value of food fed group in 2 weeks ..... $	7 59	7 25	8 37	8 78	8 42	8 12	8 25	8 60
" 1 cow in 1 day ..... Cts.	13·5	12·75	15	15·6	15	14·7	14·9	15·3
Milk produced by group in 2 weeks ..... Lbs.	1,286	1,623½	998	888½	944	819	906	916
First day's milk from group ..... "	92½	73	90	68	70	60½	75	69
Second " ..... "	93½	75	85½	68	70½	60½	73	69¼
Average daily yield of milk from group during 1st week ..... "	95	74¾	77¾	66	69	58	68	67½
Average daily yield of milk from group during 2nd week ..... "	90	71¾	65	61¾	66	56	60½	64
Average daily yield of milk from group during 2 weeks ..... "	92	73¾	71¼	62	67½	57½	64½	65
Next to last day's milk from group ..... "	89½	69½	67	62½	65½	56	61½	64
Last day's milk from group ..... "	87	69	69	62½	65½	55	62	64
Decrease in rate of daily milk yield in 2 weeks "	5	5	20	5½	4½	5	13	5
Per cent decrease in rate of daily milk yield p.c.	5½	6⅔	22	8	6½	8½	17	7

The cows liked the dry forage and ate about 25 per cent more dry matter when fed hay alone, but the yield of milk fell off very rapidly, as is shown by the table. The results seem to indicate quite strongly the advisability of every dairy farmer having some succulent feed to give his milch cows in addition to hay and meal.

ROOTS AND ENSILAGE, TURNIPS AND SUGAR MANGELS AND ROOTS AND ENSILAGE, SUGAR MANGELS AND SUGAR BEETS.

This experiment was not carried on quite fully for two reasons, viz.: (1) the supply of sugar beets was quite limited, and (2) the effect of the turnips on the butter was very injurious.

—		Method of Feeding.					
		Group G.			Group H.		
		1st Period.	2nd Period.	3rd Period.	1st Period.	2nd Period.	3rd Period.
		Regular Ration.	Turnips, Hay, Meal.	Sugar Mangels, Hay, Meal.	Regular Ration.	Sugar, Mangels, Hay, Meal.	Sugar Beets, Hay, Meal.
		Number in group, 4.	Number in group, 4.	Number in group, 4.	Number in group, 3.	Number in group, 3.	Number in group, 3.
Average weight to start	Lbs.		1,000	1,016		1,003	1,002
Average weight at end of 2 weeks	"		1,016	1,051		1,002	1,037
Loss — or gain +	"		+7	+35		−1	+35
Meal fed group in 1 day	"	30	25½	23	22	22½	20
Hay " "	"	12	20	20	9	15	15
Roots and ensilage fed group in 1 day	"	200			150		
Sugar mangels " "	"			280		218	
Turnips " "	"		277				
Sugar beets " "	"						210
Meal fed in 2 weeks	"	420	357	322	308	315	280
Hay "	"	168	280	280	126	210	210
Roots and ensilage fed in 2 weeks	"	2,800			2,100		
Sugar mangels	"			3,920		3,050	
Sugar beets fed in 2 weeks	"						2,940
Turnips	"		3,880				
Value of food fed group in 2 weeks	$	7·59	8 43	8 12	5 62	6 94	7 94
" 1 cow in 1 day	Cts.	13·5	15	14·5	13·3	16·5	18·8
Milk produced by group in 2 weeks	Lbs.	928	806	692½	836½	760	835½

ROOTS AND ENSILAGE, SUGAR MANGELS AND SUGAR BEETS.—*Con.*

—		Method of Feeding.					
		Group G.			Group H.		
		1st Period.	2nd Period.	3rd Period.	1st Period.	2nd Period.	3rd Period.
		Regular Ration.	Turnips, Hay, Meal.	Sugar Mangels, Hay, Meal.	Regular Ration.	Sugar Mangels, Hay, Meal.	Sugar Beets, Hay, Meal.
		Number in group, 4.	Number in group, 4.	Number in group, 4.	Number in group, 3.	Number in group 3.	Number in group, 3.
First day's milk from group	"	71½	60½	54	60½	59	57½
Second " "	"	71	59½	55	63	57	58¼
Average daily yield of group during 1st week	"	68¼	61	50½	61½	55½	58
Average daily yield of group during 2nd week	"	64½	54	48½	57¾	54	61½
Average daily yield of group during 2 weeks	"	66¼	57¾	50	60	54	60
Next to last day's milk from group	"	64	53	48½	57	54	60½
Last day's milk from group	"	62½	55	48	58	56	60
Decrease in rate of daily milk yield in 2 weeks	"	8	6	6	4½	1	increase. 2
Per cent decrease in rate of daily milk yield	p.c.	11	10	11	7	1½	3½

Turnips were found to be more expensive to produce than ensilage and the other roots. They do not prevent the decrease in the quantity of milk. Moreover, unless care be taken in the feeding they will give a strong, disagreeable taint to the milk or butter.

It will be seen on reference to the above table, that sugar beets not only overcame the decrease in quantity of milk, but actually produced an increase. However, the cost of sugar beets is higher than that of sugar mangels.

TWO FEEDS VS. THREE FEEDS DAILY.

Many feeders claim that it is advantageous to feed their cows three times a day instead of twice, though the same total quantity of each feed be fed daily. To determine the result of such a system, an experiment was carried on, and shows the following:—

	Summaries.	
	Summary.	Summary.
	3 feeds.	2 feeds.
	Number in group, 4.	Number in group, 4.
Average weight to start	1,337 lbs.	1,334
Average weight at end 2 weeks	1,344 "	1,344
Loss – or gain +	+ 7	+10
Meal fed group in 1 day	26½ lb.	26¼
Hay " " 1 "	20	20
Ensilage and roots fed group in 1 day	256	263
Meal fed group in 2 weeks	374	367
Hay " "	280	280
Ensilage and roots fed group in 2 weeks	3,590	3,689
Value of feed fed group "	$8.32	$8.34
Value of feed fed 1 cow in 1 day	15 cts.	14·5
Milk produced by group in 2 weeks	439	506
First day's milk from group	36	37½
Second " "	36	37
Average daily yield of group during 1st week	35½	36½
" " 2nd "	34½	36
" " 2 weeks	34½	36
Next to last day's milk from group	34	35
Last day's milk from group	35	34½
Decrease in rate of daily milk yield in 2 weeks	1½	1½
Per cent decrease in rate of daily milk yield	8%	6%

It will be seen therefore that two feeds per day fed at regular hours are more profitable than three feeds. Two feeds per day produced with less labour a larger quantity of milk.

REFUSE APPLES AS FEED FOR MILCH COWS.

Since every year the farmer has a greater or less quantity of low grade apples to dispose of, a few experiments in feeding these to dairy cows were carried on at the Central Experimental Farm with a view to studying their effects upon milk secretion and upon the health of the animals.

Fed no Apples.

Number of cows in experiment	4
Average daily ration fed each cow during 2 weeks previous to feeding experiment and 2 weeks after apple feeding experiment.	
Ensilage and roots	50 lbs.
Hay	4 "
Meal	7½ "

Feed consumed by group in average 2 weeks.

Ensilage and roots	2,800 "
Hay	224 "
Meal	420 "
Value of feed in average 2 weeks	$ 7.78
Cost to feed 1 cow 1 day	13·9 cts.
Milk yielded by group in average 2 weeks	1,353 lbs.
Daily average for cow during 2 weeks	24·2 "

Fed Apples in Ration.

Average daily ration for each cow during 2 weeks on experiment.

Apples	25 lbs.
Roots and ensilage	20 "
Hay	4 "
Meal	7½ "

Guernsey Cow—Dolly Dimple—19144.
Produced 14009·13 lbs. of 5·02 per cent milk or 703·36 lbs. butter fat as a 2 yr. old.

Feed consumed by group in 2 weeks while experiment lasted.

Apples	1,400 lbs.
Roots and ensilage	1,120 "
Hay	224 "
Meal	420 "
Value of feed, other than apples, fed during 2 weeks	$ 6.10
Cost to feed one cow 1 day (apples not valued)	10·9 cts.
Milk yielded by group in 2 weeks while eating apples	1,395 lbs.
Daily average for cow during 2 weeks	24·9 "
Difference in milk yield in favour of apple ration, for 2 weeks	42 "
Average weight of cows when going on apple feeding period	985 "
Average weight of cows at end of apple feeding period	1,008 "
Gain in weight on average	23 "
Average weight at end of last 2 weeks	992 "
Loss in average weight during 2 weeks	16 "

The cows seemed to relish the apples, thrived upon them and were very favourably affected as to health. A saving of roots and ensilage was effected, and calculating the value of refuse apples on the basis arrived at in this experiment, their value, when roots and ensilage are valued at $2 per ton, is $2.40 per ton, or 7 cents a bushel.

Calves given a few apples each day seemed to like them and did well on them.

EXPERIMENT IN FEEDING 'MEAL SEEDS.'

'Meal Seeds' is a by-product from cereal food factories and consists of a certain quantity of small grains, refuse from the manufacturing process, and weed seeds, the whole being ground together.

An experiment was carried on with 4 Shorthorn cows for 28 days to determine the feeding value of meal seeds. For the first 11 days the usual rations were fed, but in the later 17 days, while the roughage ration was the same, meal seeds at the rate of 8 lbs. per day were fed instead of a like quantity of a mixture of 600 lbs. bran, 300 lbs. oats and 300 lbs. oil meal. The following is a table of the findings:—

Number of cows under test	4
Average meal ration (bran, oats, oil meal) before test	8 lbs
Average hay ration before test	5 "
Average ensilage and roots ration before test	70 "
Average yield of milk per day during 11 days while on regular meal ration	88 6/11 "
Milk produced by group first day of 11-day period	90 "
Milk produced by group average of last 7 days before feeding 'Meal Seeds'	88 "
Average yield of milk per day for 17 days while being fed 'meal seeds'	80 1/3 "
Average yield of milk per day during first week on 'meal seeds'	83 5/7 "
Average yield of milk per day during last three days on 'meal seeds'	78 1/2 "
Rate of decrease	10%
Normal rate of decrease for period	5%

The 'Meal Seeds' did not appear to be quite so palatable to the cattle as the meal mixture of bran, oats and oil meal and the rate of decrease of production was doubled while the 'Meal Seeds' were being supplied. As a sole grain feed, 'Meal Seeds' cannot, therefore, be recommended, but may be profitably fed as part of the meal ration when other feeds are expensive.

EXPERIMENT IN FEEDING 'PEA DUST.'

Pea dust is another by-product of cereal food factories, and in order to determine its worth as a feed for dairy cattle, an experiment was carried on with the result given below. For the amount of the regular meal ration an equal amount of pea dust was substituted.

Number of cows under test	4
Average meal ration (bran, oats, oil meal) before test	8 lbs.
Average hay ration before test	5 "
Average ensilage and roots before test	60 "

Average yield of milk per day for 11 days while on regular meal ration..	88 1/11 lbs.
Milk produced by group first day of 11-day period..	89½ "
Milk produced by group average of last 7 days before being fed 'pea dust'..	87 5/7 "
Average yield of milk per day for 17 days while being fed 'pea dust'..	84⅓ "
Average yield of milk per day during first week while being fed 'pea dust'..	85 1/7 "
Average yield of milk per day for last 3 days while being fed 'pea dust'..	85⅓ "
Rate of decrease..	4½%
Normal rate of decrease for period.. ..	5%

Though the cattle did not like the pea dust, and some difficulty was experienced in getting them to eat the whole amount supplied, yet the results compare very favourably with what might have been expected from the regular ration. It will be seen that the rate of decrease for the period was reduced below the normal.

EXPERIMENT WITH 'SPIRIT GRAINS.'

'Spirit Grains,' a product of distilleries, was substituted at the rate of 8 lbs. per day for the regular grain ration which was fed in a similar quantity. The roughage ration was the same as was supplied before the experiment was begun.

Number of cows under test..	4
Average meal ration (bran, oats, oil meal) before test..	8 lbs.
Average hay ration before test..	5 "
Average ensilage and roots ration before test..	60 "
Averaye yield of milk per day during 11 days before feeding of 'spirit grains' began..	80⅓ "
Milk yielded by group first day of 11-day period..	81¼ "
Milk yielded by group average of last 7 days before feeding 'spirit grains'..	79 5/7 "

Average yield of milk per day for 17 days while being fed 'spirit grains'.. ..	79¾ lbs.
Average yield of milk per day for first week on 'spirit grains'..	75⅛ "
Average yield of milk for last 3 days on 'spirit grains'..	83 "
Rate of decrease..	½%
Normal rate of decrease for period.. ..	5%

The cows liked the spirit grains, and the natural tendency of the milk production to decrease was reduced from 5 per cent to ½ per cent. Spirit grains may, therefore, be taken as a very profitable feed.

ROOTS VS. ENSILAGE.

This experiment was undertaken to find out whether the addition of a certain proportion of roots to the ensilage ration would in any way influence the yield of milk.

The roots were mixed with the ensilage in the proportion of 100 lbs. of roots to 200 lbs. of corn ensilage. In both the period prior to the commencement of the experiment and the period during which the experiment was carried on, the cows were given all they would eat of the succulent part of the ration, in addition to a regular meal ration, viz., 1 pound meal to every 3 pounds of milk produced.

Following is a summary of the results:—

Item Considered.		Ration Fed.		
		Preliminary Period.	1st Period, no Roots.	2nd Period, Roots.
Period.		Dec. 25 to Jan. 1, 1907.	Jan. 2 to Jan. 22.	Jan. 23 to Feb. 13.
Number of days on feed		7	21	21
Amount meal mixture consumed in period	Lbs.	658	2,016	1,89J
Average amount meal per cow per day.	"	5·5	5·6	5·29
Amount ensilage consumed by group in period	"		16,800	
Amount roots and ensilage consumed by group in period	"	6,070		20,040
Average amount of ensilage per cow per day	"		47	
Average amount of roots and ensilage per cow per day	"	51·0		56·1
Total milk in average day of period.	"	221·9	267·8	235·6
Total milk produced by group in period.	"	1,553·5	5,624·5	4,949
Total milk produced by group in 1st 3 days of period	"	655·5	752	773·5
Total milk produced by group in last 3 days of period	"	684·5	800	680
Value of food consumed by group during period	$	13 80	40 65	42 69
Value of food consumed by group in 1 day	$	1 97	1 93·5	2 03
Cost of 100 lbs. milk produced by group during period	Cts.	88·8	70·5	86·2
Cost of 100 lbs. milk produced by group during 1st 3 days	"	90·2	67·1	78·7
Cost of 100 lbs. milk produced by group during last 3 days	"	86·3	72·5	89·6
Normal rate of decrease in milk-flow during period	Lbs.	2·5%	7·5%	7·5%
Rate of decrease − or increase + during period	"		+6·3%	−12%

The results do not show up very strongly in favour of the roots, the increase in cost of production of 100 lbs. milk being raised by their use from 70·5 cents to 86·2 cents, an increase of 15·7 cents.

EXPERIMENTS WITH INTERNATIONAL STOCK FOOD FOR DAIRY COWS.

In order to get some information as to the value of International Stock Food as an addition to the ration of dairy cows in milk, an experiment was carried on in 1905 with the following result:—

—		Summary. Fed Stock Food. Number in group 3.	Summary. Fed no Stock Food. Number in group 3.
Ensilage fed group in 1 day	Lbs.	355	310
Stock Food fed group in 1 day	Ozs.	6	.....
Meal fed group in period	Lbs.	766·6	806
Hay fed group in period	"	168	161
Ensilage fed group in period	"	7,035	6,720
Stock Food fed group in period	"	7·8	.....
Value of feed fed group in period	$	15 29	15 53
Value of feed fed 1 cow in 1 day	Cts.	12·1	12·3
Milk produced by group in period	Lbs.	2,066	2,147
First day's milk from group	"	109·5	116
Second " "	"	107	114·5
Average daily yield of group during 1st week	"	104·4	108·8
" " 2nd "	"	93	96·3
" " 3 weeks	"	98·3	99·8
Next to last day's milk from group	"	94·5	99·8
Last day's milk from group	"	92·5	94
Cost to produce 100 lbs. milk during period	Cts.	74	72·3

It will be seen from the above table that International Stock Food is not of very great value as a food for dairy cattle. In the case where a quantity of it was substituted for a like quantity of the regular meal ration, the cost of producing 100 lbs. of milk was raised from 72·3 to 74 cents.

MANGELS VS. MEAL.

A test was made of three small groups of cows (three cows to the group) which were far advanced in the lactation period, to gain some information as to the possibility of replacing the meal ration, or some part thereof, by mangels.

An outline of the experiment is as follows:—

First period, February 15-21, 1910.

Lot 1.—Alma, Fannie, Gurta.

Daily ration per cow.—Meal mixture, 1 lb. for each 3 lbs. milk produced; long straw, 3 lbs.; sorghum ensilage, 100 lbs.; cut straw, 16 lbs. What each cow would eat up clean.

Lot 2.—Soncie, Bessie, Jessie E.

Daily ration per cow.—Same as Lot 1.

Lot 3.—Queenie, Robichaud, La Belle.

Daily ration per cow.—Same as Lot 1.

Second period, February 22-March 7, 1910.

Lot 1. Daily ration per cow.—Same as period 1.

Lot 2. Daily ration per cow.—Roughage, same as period 1; mangels, 3 lbs. for each pound milk produced; no meal.

Lot 3. Daily ration per cow.—February 22-28, roughage, same as period 1; meal, 1 lb. to 4 lbs. milk produced; mangels, ½ lb. to 1 lb. milk produced. March 15-21, meal, 1 lb. to 7 lbs. milk produced; mangels, 1 lb. to 1 lb. milk produced.

Third period, March 1-8, 1910.

Lot 1. Daily ration per cow.—Roughage, same as period 1; mangels, 3 lbs. to 1 lb. milk produced.

Lot 2. Daily ration per cow.—Same as period 1.

Lot 3. Daily ration per cow.—March 8-14, roughage, same as period 1; meal, 1 lb. to 6 lbs. milk produced; mangels, 1½ lb. to 1 lb. milk produced. March 15-21, Meal, 1 lb. to 7 lbs. milk produced; mangels, 2 lbs. to 1 lb. milk produced.

Meal mixture.—Bran, 500 lbs.; beet pulp, 200 lbs.; beet and molasses pulp, 200 lbs.; cottonseed meal, 100 lbs.

Cows weighed.—Monday, February 14, 10 a.m.; Tuesday, March 22, 10 a.m.

1909-10.	First Period of one week. All Groups Fed Alike.			Second Period of two weeks.			Third Period of Two Weeks.		
	Lot 1.	Lot 2.	Lot 3.	Lot 1.	Lot 2.	Lot 3.	Lot 1.	Lot 2.	Lot 3.
Number of cows in group	3	3	3	3	3	3	3	3	3
Average weight to start	1,007	766	699	1,012	764	811	1,015	743	813
Average weight at end of period	1,012	764	811	1,015	743	813	1,010	777	812
Loss − or gain +	+5	−2	+12	+3	−21	+2	−5	+34	−1
Meal fed group in 1 day	17·2	16·4	9·2	16·8	9	5·4	.....	11·7	2·6
Sorghum ensilage fed group in 1 day — Sorghum, 100 lbs. / Cut straw, 16 "	129	119	114	130·3	64·3	120	76·3	110	120
Roots fed group in 1 day	.....	.....	.....	.....	118·6	6	126	.....	28·2
Long straw fed group in 1 day	9	9	9	9	9	9	9	9	9
Meal fed group during period	120·7	115·2	64·2	236	.....	75·4	.....	164·7	37·5
Sorghum ensilage fed group during period. — Sorghum, 100 lbs. / Cut straw, 16 "	900	830	795	1,825	901	1,680	1,070	1,540	1,680
Roots fed group during period	.....	.....	.....	.....	1,661	84	1,765	.....	395
Long straw fed group during period	63	63	63	126	126	126	126	126	126
Values of feed fed group during period $	2·78	2·57	1·91	5·54	2·82	3·28	3·25	4·25	3·08
Value of feed fed 1 cow in 1 day ..... c.	13·2	12·3	9·1	13·2	6·7	7·5	7·7	10·1	7·3
Milk produced by group during period.lbs	363	328	180	699	515	230	579	503	212
First week's milk from group ..... "	.....	.....	.....	351	277	153	312	247	118
Last week's milk from group ..... "	.....	.....	.....	348	238	137	267	256	94
Average daily yield of milk of group during 1st week	52·5	47	25·7	50	39·6	21·9	44·5	35·3	16·9
Average daily yield of milk of group during 2nd week	.....	.....	.....	49·7	34·0	19·6	38·1	36·5	13·4
Decrease in rate of daily milk yield	.....	.....	.....	·3	5·6	2·3	6·4	1·2	3·5
Decrease in quantity of milk produced by group from period 1 to last week in period 3	.....	.....	.....	.....	.....	.....	96	72	86
Rate per cent of decrease in 4 weeks ...p.c.	.....	.....	.....	.....	.....	.....	26	22	48

2788—p. 160.

Holstein Cow and Calf—Evergreen March. Produced 26,107·50 lbs. milk and 1129·4 lbs. butter 80% fat in 1 yr. as a mature cow.

The feed for each cow was carefully weighed at each feeding.

The results indicate the danger of depending too much on roots for cows far advanced in lactation.

A COMPARISON OF GLUTEN, OIL MEAL AND COTTON-SEED MEAL WITH BRAN AND OATS.

During the winter of 1906-07, an experiment was undertaken to gain some information as to the value of gluten, oil meal and cottonseed meal as feeds in comparison with bran and oats. Each group contained four cows.

The tables which follow give a full history of the experiment.

VALUES OF MIXTURES.

	Per ton.
Oats and bran mixture, equal parts	$20 00
Oats, bran and gluten meal mixture, equal parts	21 60
Oats, bran and oil meal mixture, equal parts	23 40
Oats, bran and cottonseed meal mixture, equal parts	23 60

These were the prices the feeds cost us.

GROUP I.

Item considered.	Meal Mixture Fed.				
	Preliminary Oats 100, Bran 100,	Oats 100, Bran 100.	Oats 100, Bran 100, Oil meal 100.	Oats 100, Bran 100. Gluten 100	Oats 100, Bran 100, Cotton seed meal 100.
Period.	Feb. 21 to Mar. 6.	Mar. 7 to Mar. 20.	Mar. 21 to April 3.	April 4 to April 17	April 18 to May 2.
Number of days on feed.....	14	14	14	14	14
Amount meal mixture consumed in period	364 lbs.	364 lbs.	364 lbs.	364 lbs.	364 lbs.
Average amount meal per cow per day.....	6½ "	6½ "	6½ "	6½ "	6½ "
Amount roots and ensilage consumed by group in period.	2,660 "	2,380 "	2,359 "	2,338 "	1,826 "
Average amount roots and ensilage per cow per day...	47·5 "	43 "	42 "	41·5 "	32½ "
Amount hay consumed by group in period.....	168 "	168 "	168 "	168 "	168 "
Total milk in average day of period.....	86 "	82 "	76·5 "	82 "	86 "
Total milk produced by group in period.....	1,210½ "	1,147 "	1,145 "	1,148½ "	1,117½ "
Total milk produced by group in first three days of p riod	258·5 "	250 "	243½ "	241 "	247 "
Total milk produced by group in last three days of period.	255 "	244 "	241 "	242 "	241 "
Value of food consumed by group during period.....	$6 89	$6 61	$7 21	$6 86	$6 71
Value of food consumed by group in one day.....	0 49 3/14	0 47 5/14	0 51½	0 49	0 47 13/14
Cost of 100 lbs. milk produced by group during period..	0 57	0 57·6	0 63	0 60	0 60
Cost of 100 lbs. milk produced by group during first three days of period.....	0 56·3	0 56·7	0 63	0 60	0 58·2
Cost of 100 lbs. milk produced by group during last three days of period.....	0 57·9	0 58·1	0 64	0 60	0 59·7
Normal rate of decrease in milk flow during period....	4 p.c.	4 p.c.	4 p.c.	4 p.c.	4 p.c.
Rate of decrease –, or increase +, during period.....	–1·3 p.c.	–2·3 p.c.	–1 p.c.	+ .4 p.c.	–2·4 p.c.
Average per cent of fat in milk during period	4·4 p.c.	4·6 p.c.	4·6 p.c.	4·4 p.c.	4·4 p.c.

Group II.

Item Considered.	Meal Mixture Fed.				
	Preliminary Bran 100, Oats 100.	Oats 100, Bran 100, Oil meal 100.	Oats 100, Bran 100, Gluten 100.	Oats 100, Bran 100, Cotton seed meal 100.	Bran 100, Oats 100.
Period.	Feb. 21 to Mar. 6.	Mar. 7 to Mar. 20.	Mar. 21 to April 3.	April 4 to April 17.	April 18 to May 2.
Number of days on feed.....	14	14	14	14	14
Amount meal mixture consumed in period.....	308 lbs.	308 lbs.	308 lbs.	308 lbs.	308 lbs
Average amount meal per cow per day	5½ "	5½ "	5½ "	5½ "	5½ "
Amount roots and ensilage consumed by group in period	2660 "	2520 "	2506 "	2492 "	1960 "
Average amount roots and ensilage per cow per day.....	47·5 "	45 "	$44\frac{3}{11}$ "	44½ "	35 "
Amount hay consumed by group in period.....	168 "	168 "	168 "	168 "	168 "
Total milk in average day of period	72 "	70 "	72 "	71 "	67·6 "
Total milk produced by group in period.....	1003 "	986½ "	1005½ "	988½ "	947·5 "
Total milk produced by group in first three days of period.	215·5 "	209½ "	216½ "	214 "	211 "
Total milk produced by group in last three days of period.	210½ "	212½ "	217½ "	212½ "	197 "
Value of food consumed by group during period.....	$6 33	$6 71	$6 43	$6 71	$5 63
Value of food consumed by group in one day.....	0 $45\frac{3}{14}$	0 $47\frac{13}{14}$	0 $45\frac{13}{14}$	0 $47\frac{13}{14}$	0 $40\frac{3}{14}$
Cost of 100 lbs. milk produced by group during period....	0 63	0 68	0 64	0 67·8	0 59·4
Cost of 100 lbs. milk produced by group during first three days of period	0 63	0 68·2	0 64	0 67·3	0 57·2
Cost of 100 lbs. milk produced by group during last three days of period.....	0 64·4	0 67·3	0 64	0 67·9	0 61·2
Normal rate of decrease in milk-flow during period....	4 p.c.	4 p.c.	4 p.c.	4 p.c.	4 p.c.
Rate of decrease − ; or increase + ; during period...	−2·0 p.c.	+1·5 p.c.	+0·4 p.c.	−0·7 p.c.	−6·6 p.c.
Average per cent of fat in milk during period.....	4·2 p.c.	4·7 p.c.	4·7 p.c.	4·7 p.c.	4·5 p.c.

GROUP III.

Item Considered.	Meal Mixture Fed.				
	Preliminary Bran 100, Oats 100.	Oats 100, Bran 100, Gluten 100.	Oats 100, Bran 100, Cotton seed meal 100.	Oats 100, Bran 100.	Oats 100, Bran 100, Oil meal 100.
Period.	Feb. 21 to Mar. 6.	Mar. 7. to Mar. 20.	Mar. 21 to April 3.	April 4 to April 17.	April 18 to May 2.
Number of days on feed.....	14	14	14	14	14
Amount meal mixture consumed in period	308 lbs.	308 lbs.	308 lbs.	308 lbs.	308 lbs.
Average amount meal per cow per day.....	5½ "	5½ "	5½ "	5½ "	5½ "
Amount roots and ensilage consumed by group in period.....	2590 "	2380 "	2359 "	2338 "	1,820 "
Average amount roots and ensilage per cow per day.....	46$\frac{1}{7}$ "	42½ "	42 "	42 "	32½ "
Amount hay consumed by group in period.....	168 "	168 "	168 "	168 "	168 "
Total milk in average day of period..... .	76 "	77 "	76 "	71 "	66 "
Total milk produced by group in period..	1063½ "	1077½ "	1061½ "	977 "	932 "
Total milk produced by group in first three days of period.	228 "	223 "	230 "	217½ "	207½ "
Total milk produced by group in last three days of period.	228½ "	233 "	224½ "	206½ "	199 "
Value of food consumed by group during period.....	$6 26	$6 30	$6 58	$6 01	$6 01
Value of food consumed by group in one day	0 44$\frac{10}{14}$	0 45	0 47	0 42$\frac{13}{14}$	0 42$\frac{13}{14}$
Cost of 100 lbs. milk produced by group during period....	0 59	0 58·5	0 62	0 61·5	0 64·5
Cost of 100 lbs. milk produced by group during first three days of period.	0 59	0 60·5	0 61	0 59·3	0 62·3
Cost of 100 lbs. milk produced by group during last three days of period.....	0 59	0 58	0 63	0 62·4	0 64·8
Normal rate of decrease in milk-flow during period....	4 p.c.	4 p.c.	4 p.c.	4 p.c.	4 p.c.
Rate of decrease −; or increase +; during period...	−	+4·4 p.c.	−2·6 p.c.	−5 p.c.	−4 p.c.
Average per cent of fat in milk during period.....	4·2 p.c.	4·7 p.c.	4·9 p.c.	4·5 p.c.	4·2 p.c.

GROUP IV.

Item Considered.	Meal Mixture Fed.				
	Preliminary, Bran 100, Oats 100.	Bran 100, Oats 100, Cotton seed meal 100.	Bran 100, Oats 100.	Bran 100, Oats 100, Oil meal 100.	Bran 100, Oats 100, Gluten 100.
Period.	Feb. 21 to Mar. 6.	Mar. 7 to Mar. 20.	Mar. 21 to Apl. 3.	Apl. 4 to Apl. 17.	Apl. 18 to May 2.
Number of days on feed.	14	14	14	14	14
Amount meal mixture consumed in period	392 lbs.	392 lbs.	392 lbs.	392 lbs.	392 lbs.
Average amount meal per cow per day.	7 "	7 "	7 "	7 "	7 "
Amount roots and ensilage consumed by group in period	2,660 "	2,660 "	2,590 "	2,520 "	2,030 "
Average amount roots and ensilage per cow per day...	47½ "	47½ "	46¼ "	45 "	36¼ "
Amount hay consumed by group in period.....	168 "	168 "	168 "	168 "	168 "
Total milk in average day of period..... ...	87½ "	88 "	83 "	83 "	82 "
Total milk produced by group in period.....	1,225½ "	1,233 "	1,166 "	1,167½ "	1,149 "
Total milk produced by group in first three days of period	266 "	257 "	259 "	246½ "	250 "
Total milk produced by group in last three days of period.	264½ "	267½ "	246½ "	254 "	252 "
Value of food consumed by group during period.	$ 7 17	$ 7 88	$ 7 10	$ 7 70	$ 6 85
Value of food consumed by group in one day.....	0 51 3/14	0 56 4/14	0 50 10/14	0 55	48 1/1
Cost of 100 lbs. milk produced by group during period....	0 59	0 64	0 61	0 66	0 59·
Cost of 100 lbs. milk produced by group during first three days of period	0 60	0 66	0 59	0 67	0 58
Cost of 100 lbs. milk produced by group during last three days of period	0 59	0 63	0 61·5	0 65	0 58 2
Normal rate of decrease in milk flow during period....	4 p.c.	4 p.c.	4 p.c.	4 p.c.	4 p.c.
Rate of decrease—; or increase +; during period.....	−1 p.c.	+2·5 p.c.	−5 p.c.	+3·2 p.c.	+·8 p.c
Average per cent of fat in milk during period.....	4·3 p.c.	4·4 p.c.	4·4 p.c.	4·8 p.c.	4·4 p.c

SUMMARY.

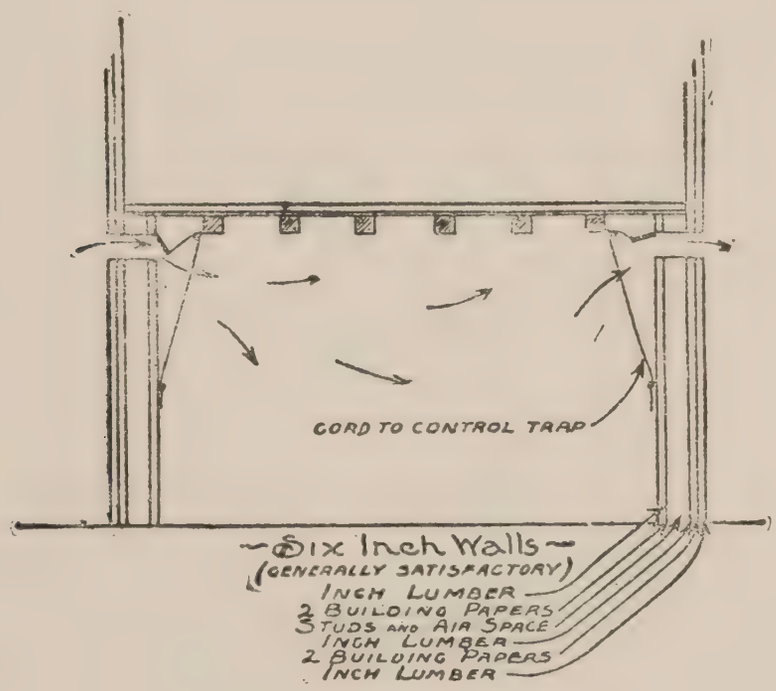
Item Considered.	Meal Mixture Fed.				
	Preliminary, Oats 100, Bran 100.	Oats 100, Bran 100.	Oats 100, Bran 100, Oil meal 100.	Oats 100, Bran 100, Gluten 100.	Oats 100, Bran 100, Cotton seed meal 100.
Period.	—	—	—	—	—
Number of days on feed. ...	14	14	14	14	14
Amount meal mixture consumed in period.....	1,372 lbs.	1,372 lbs.	1,372 lbs.	1,372 lbs.	1,372 lbs.
Average amount meal per cow per day	6·1„	6·1„	6·1„	6 1„	6·1„
Amount roots and ensilage consumed by group in period	10,570 „	9,268 „	9,219 „	9,254 „	9,331 „
Average amount roots and ensilage per cow per day ..	47·2„	41·5„	41 „	41·1„	41·6„
Amount hay consumed by group in period.	672 „	672 „	672 „	672 „	672 „
Total milk in average day of period.....	320·5„	393·6„	295·5„	313 „	321 „
Total milk produced by group in period.	4,502·5„	4,237·5„	4,231·5„	4,380·5„	4,400·5„
Total milk produced by group in first three days of period	998 „	937·5„	907 „	940·5„	948 „
Total milk produced by group in last three days of period.	958·5„	893 „	906·5„	944·5„	945·5„
Value of food consumed by group during period. ...	$ 26 65	$ 25 35	$ 27 63	$ 26 44	$ 27 88
Value of food consumed by group in one day.....	1 90·4	1 81·1	1 96·6	1 48·8	1 99·1
Cost of 100 lbs. milk produced by group during period....	0 59·1	0 59·8	0 65·3	0 60·3	0 63·3
Normal rate of decrease in milk flow during period. ..	4 p.c.	4 p.c.	4 p.c.	4 p.c.	4 p.c.
Rate of decrease—; or increase +; during period.....	—3·1 p.c.	—3·7 p.c.	—	+ ·4 p.c.	— ·2 p.c.
Average per cent of fat in milk during period.....	4·3 p.c.	4·5 p.c.	4·6 p.c.	4·5 p.c.	4·6 p.c.

It was found, as will be seen from the above tables, that while these feeds, especially oil meal and gluten, checked the falling-off in milk flow, they at the same time raised the cost of production so that the period when bran was being fed holds first place in economy. The gluten meal period is very close behind, however, and has the advantage of having not only checked the natural decrease in milk flow but even induced a slight increase.

EXPERIMENTS IN VENTILATION OF DAIRY BARNS.

Many systems of ventilation for cattle barns have been devised and advocated by many experimenters. The writer has tried between 25 and 30 different systems within the last ten years. Most methods tried have proven more or less objectionable. Of all the systems advocated, that commonly known as 'The Rutherford System of Stable Ventilation' would appear to be the one most worthy of trial. A system known as the King System has been widely advocated. It proved quite unsatisfactory here. It would seem to be better suited for warmer countries. Below are submitted descriptive cuts and brief explanatory notes of a number of systems or methods.

SYSTEM OF VENTILATION 'A.'—PIERCED WALLS.



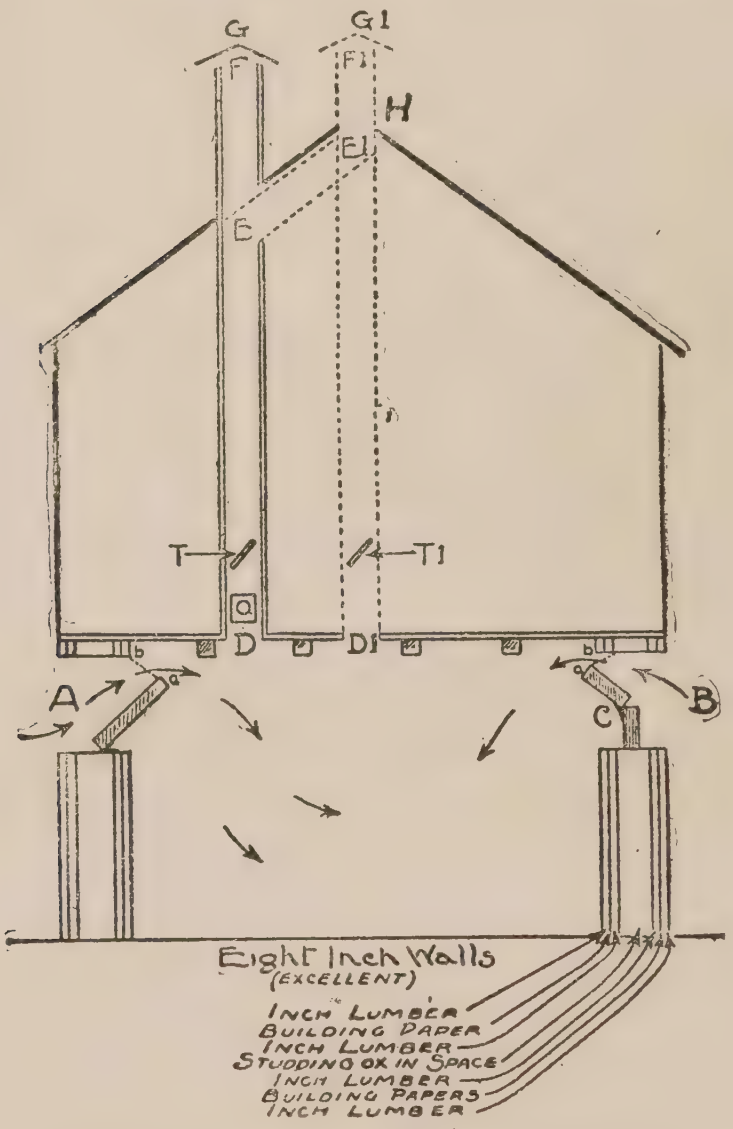
(Plan A—Pierced Walls.)

This system of ventilation is simple and cheap of installation. All that is required is the piercing of square or round holes on all sides exposed to air. These holes or openings in our standard stable (30 x 36) should be 4 inches in diameter at three feet intervals, or 6 inches in diameter at six feet intervals in at least three sides of the building. They had better be provided with some sort of door or key to control either incoming or outgoing currents of air. The fresh air will, if permitted, enter from the side against which the

wind strikes. Hence the openings serving as inlets one day or at one moment may be outlets the next moment or any other day, depending of course upon the direction of the wind. When calm prevails, internal influences will exert the controlling forces as to which openings shall act as inlets and which others as outlets.

The controlling and limiting of the rate of inflow of air is essential. The outflow will usually require that the controls or keys be fully open. The temptation to partially plug the holes with wisps of hay or straw must be guarded against.

SYSTEM OF VENTILATION 'B.'—VENTILATION BY CONVECTION.



Plan B—Ventilation by Convection.

In the system described below, the proper distribution of pure air throughout the stable depends for the most part upon convection or circulation of air in the lower half of the stable due to the heat

PLATE XXXV.

Ayrshire Cow—Netherhall Brownie IX. Produced 1025·11 lbs. butter 80 per cent fat in 1 yr.

from the animals causing displacement of the lower air which, when warmed, will ascend and be replaced by cool, fresh air entering by 'A' or 'B' or by both or numerous similar openings.

The impure air leaves the stable by outlet 'D.'

C C are windows hinged at the bottom and held in position by small chains from a to b. The windows may be of any desired width or height. If very high it is advisable to have the lower half stationary and the upper hinged thereto as in B.

The outlet D E F for such a stable as mentioned, if single, should be about two feet square. If it is preferred to have two outlets, as is probably somewhat better, then each outlet should be 1½ feet square. This outlet pipe D E F may be in the centre or to one side. So far as satisfactory working is concerned, I may say that we have had almost equally good results when the pipe took the courses D E F, D E E′ F′ or D′ E′ F′ provided always that the outlet F or F′ was 2 or 3 feet higher than H the apex of the roof. To prevent in some measure the inflow of snow or rain, a cap G should be constructed over the outlet pipe. If conveniently situated, D might serve as an opening through which to drop bedding or feed.

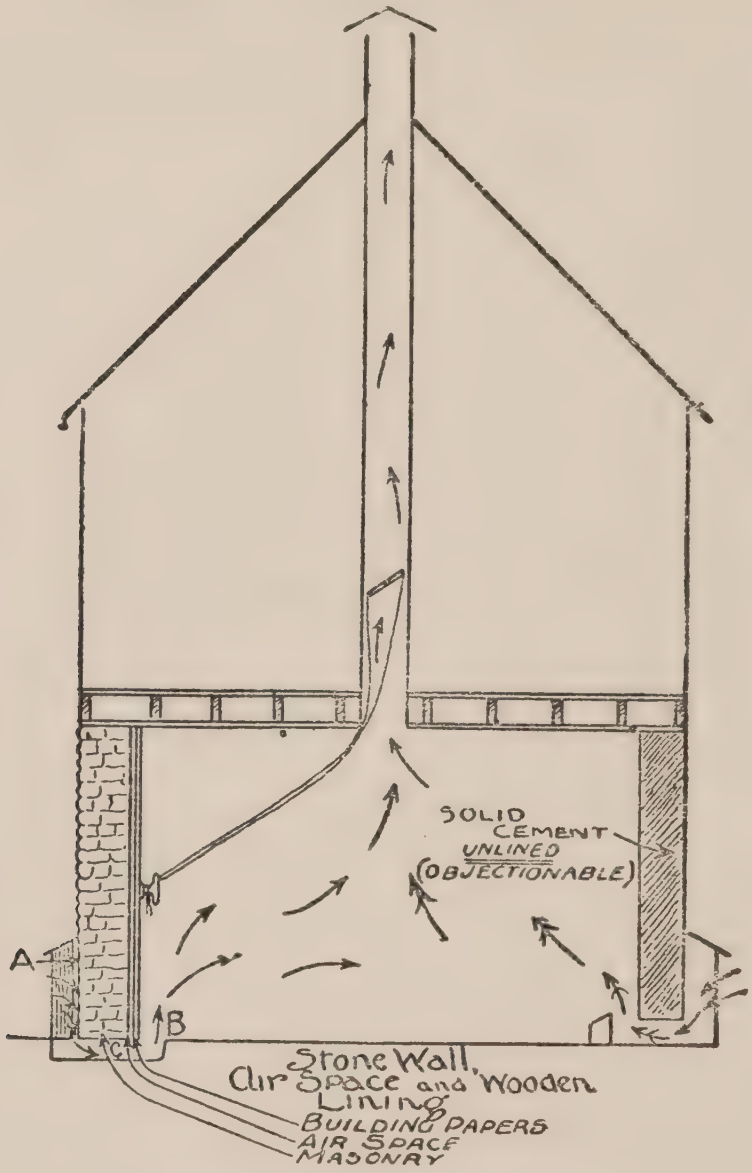
The amount of air to escape through the outlet is controlled by the trap T which may be regulated by cords descending into the stable.

SYSTEM OF VENTILATION 'C.'—THE RUTHERFORD SYSTEM.

This system is no doubt fairly well known to most readers, but a few descriptive paragraphs will probably not be out of place. It is the system most commonly used here for the reason that it has proven to be most simple of manipulation and affords the least opportunity of being badly worked or blocked by cattlemen unwisely anxious as to the comfort of their charges.

This system requires that the air enter at or near the floor level. The best plan of bringing it in is probably as shown on the left hand side in the diagram where the single-headed arrows indicate the entrance of the air and its passage through A C B under the wall. When the air current enters the stable it has an upward direction, which it retains in some degree, but, once free from the confining passage, it spreads and takes usually the course indicated by the single-headed arrow.

If for any reason it is not considered advisable to pass under the wall, then an opening through the wall at the level of the floor will serve the purpose. In such case it will, however, be found necessary to so surround the opening into the stable as to give the



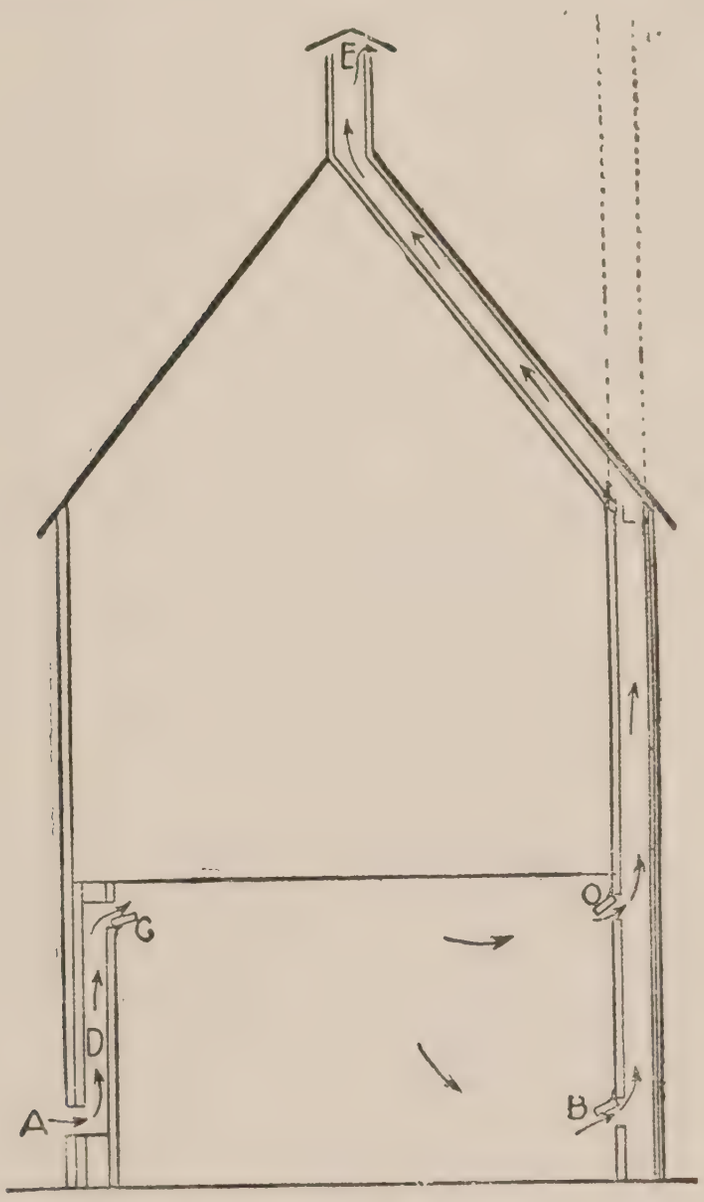
Plan C—Rutherford System.

entering air current an upward tendency. The air current would then follow the directions indicated by the double-headed arrows. As to outlet, the same plan serves as was described in writing of ventilation plan 'B.'

SYSTEM OF VENTILATION 'D.'—THE KING SYSTEM.

Like the system just discussed, the King system is probably known to many readers. It has many admirers, and many have

succeeded with it. It is most remarkable in this, that the foul air is drawn from the floor and the fresh air enters at the ceiling. In the previously discussed systems as will be remembered, the foul air in every case was drawn from the ceiling, while the fresh air came in at different points from the floor to the ceiling according to the system being considered.



Plan D—King System.

The advocates of the King System claim that since carbonic acid gas is the chief impurity in stables, and since this gas is heavier than pure air, it is likely to be found in largest quantities near the floor, and therefore outlets for impure air should begin near the floor level.

In the cross section diagram, the inlet is shown by arrows running from A to C. The outlet begins at B and the foul air goes up the tube and out at E. Both inlets and outlets occur on each side, and should be at intervals of about 10 feet, say 3 of each on each side. Where these numbers occur, then each inlet and each outlet should have a cross sectional area of at least 60 square inches, say 4 inches x 15 inches. Where it is intended to install this system, it should be provided for when building the walls. Spaces between the studs will serve for both inlets and outlets.

The outlet B L E might be modified to take the course B L M, in which case it would probably be necessary to extend M above the level of the apex of the roof. At O openings should be made into the outlets so that the warm air at the ceiling may be allowed to escape when the average stable temperature rises too high.

The chief objection to this system is the large number of long pipes or boxes necessary to admit pure air, or discharge foul air, as the case may be.

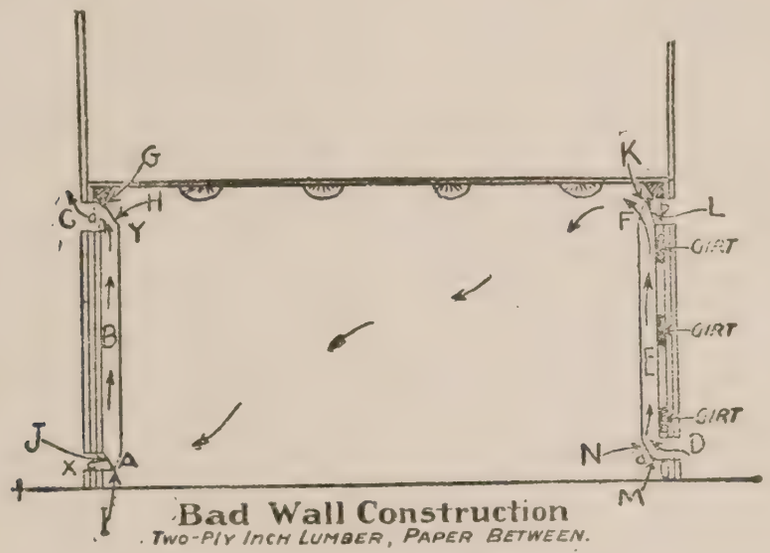
This objection is particularly in evidence when it becomes necessary to install the system in an old building. A modification of the system and one that is easy of introduction in an old or new wooden building is given below.

SYSTEM OF VENTILATION 'E.'

This system, a modification of the King, permitting of cheap and easy installation in either new or old frame or log buildings, is one which the writer devised and put into operation some years ago at the Experimental Farm and elsewhere. It has worked very satisfactorily, wherever installed. That it is cheap as well as effective is proved by the fact that in a stable for 22 cattle it cost $12 for labour and material. The pipes in this system are entirely inside the stable. For 20 cattle in the standard stable these should be six in number, each about 12 inches x 6 inches or 12 inches x 7 inches in cross section, 3 on each side (east and west sides if possible).

Each ventilation pipe must have two openings to the outside air, one an inch or so below the ceiling level as a and b, and the other 6 inches to 8 inches above the floor level as c and d. These openings should be of the same dimensions as the pipes. The air enters

the building by passing into the right hand pipe at D up past E and into the stable at F at the ceiling. It circulates through the building, enters the outlet at A, passes up through B and out at C. If the wind were blowing from the left, however, it would enter at X up through B and out into the stable at Y finding its way out by entering the right hand tube at D and passing up through E and out at B.



Plan E - Modified King System

H J L N represent barriers or trap doors hinged at G I K and M respectively. As set in diagram, air enters by D E F and discharges by A B C. If set as per dotted lines, then entry would be by X B Y and discharge by D E B.

When properly attended to this is an exceedingly satisfactory system, but when neglected does not always work well. If desired, trap doors H J L U may be arranged so as to permit of air entering directly, that is by flowing through X A and D D and leaving the stable at ceiling that is B and Y C, which would be a modified Rutherford system. This latter modification works well in warm weather.

MUSLIN CURTAIN VENTILATION SYSTEM.

Muslin curtain ventilation, a so-called system of ventilation advocated to a considerable extent in recent years, was given a thorough trial at the Central Experimental Farm and found quite unsatisfactory. The most striking faults with the system were:—

1. Too great watchfulness necessary to insure even a fair measure of success.

2. Danger of too great a fall or rise of temperature in the night, due to rise or fall of wind.

3. Darkening of stable due to presence of muslin on windows which renders stable gloomy and damp.

4. Fouling of the muslin on account of changing directions of air currents which wet the curtains permitting foul air to escape, thus preventing the escape of foul air, so the curtains soon get muddy in appearance and unsanitary in condition.

INDIVIDUAL RECORDS.

All cattle in the barns at the Central Experimental Farm are under experiment to a greater or less extent. All cattle are not necessarily in comparative tests, but a record is kept of the methods of feeding and the quantities given to each animal. Results are noted and conclusions drawn as to the values of different methods of feeding and different rations under certain conditions.

Moreover the total production of each individual is carefully recorded, its value fixed according to the price on the market for milk or butter at the time, and with the returns thus obtained, the exact profit of each cow per year is arrived at by deducting the cost of care and feeding. By this method of keeping accurate records of the feed supplied and the milk and butter fat produced, it is possible to weed out the 'boarders' from a herd. As an example of what this means to a farmer, it may be stated, as shown elsewhere in this work, that the average return per cow at the Central Experimental Farm in 1899 when this system was introduced was $51.22 while in 1911 it was $80.27, this being but slightly higher than figures obtained in some of the intervening years.

PLATE XXXVI.

Jersey Cow—Jacoba Irene—13½ years old. Champion long-distance cow.
Produced 2,053 lbs. 15·3 oz. butter, 85 per cent fat in 2 yrs.

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